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JOURNAL OF MAMMALOGY

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NOTES ON MAMMALS OF THE LABRADOR INTERIOR

BY WILLIAM DUNCAN STRONG

While the fauna of the Labrador coast has been studied in some detail, our knowledge of the vast and desolate interior region is still in a very rudimentary stage. For this reason it seems worth while to put on record such facts as could be gleaned from the native hunters who range over the little-known interior country between Hamilton Inlet and Ungava Bay. The following observations were obtained in the country of the Naskapi Indians, who are the most northeasterly representatives of the great Algonkian linguistic stock. Two groups occupy this region, the Barren Ground people who before coming to the coast some years ago lived on Indian House Lake, and the Davis Inlet band who now trade at that post although their immediate ancestors came from Northwest River. The two bands are closely united and very often live together. As a member of the Rawson-MacMillan Subarctic Expedition of the Field Museum, June, 1927, to September, 1928, the author had considerable contact with these people, and during the winter and early spring of 1928 he lived and travelled with the Davis Inlet band in the interior west of that post.

Like all northern regions, Labrador is subject to periodic fluctuations in the abundance of animal life, and the winter of 1927–1928 marked a very low ebb in the numbers of all species, resident as well as migratory. The country was lifeless beyond description, and it was not at all unusual to travel fifty or sixty miles a day in the utterly uninhabited interior and not see a single bird or animal track, let alone any living creature. In spite of constant hunting, only two snowshoe rabbits and no arctic hares were killed by the Indians. Willow ptarmigan, rock ptarmigan,

and spruce grouse were likewise very scarce, and the fur-bearers, as would be expected, were very rare. This lifelessness extended to the birds of prey, small birds of all sorts, squirrels and mice. Needless to say, the Indians were terribly pressed for food, and if several small herds of caribou had not been encountered, in addition to the trout secured in nets under the ice, many of these people would have starved to death. These periods of want are of frequent occurrence in Labrador, and the mortality from starvation among the Indians who live in the peninsula is still quite high. Formerly, when there were no trading stations and the the hostile Eskimo prevented access to the coast, their sufferings at such times were even more extreme.

The barren ground caribou, called *ah-tée-u*,[1] is the most important animal in northern Labrador from the Indians' standpoint. Not only is the greater part of their life spent in pursuit of these animals, but among the northern bands their religion is largely based on the caribou god, who may give or withhold food for the people. The Naskapi say that the caribou herds have decreased very rapidly in the last ten to fifteen years. Prior to that time it was quite usual for them to kill a thousand or more deer with spears as they swam across Indian House Lake. The main caribou herd formerly appeared there in October moving from the north and east, crossed the lake, and passed on to the south and west. In May it came back up the east side of the George River moving to the northeast. According to Indian belief, there is a high mountain in the barren grounds of northeastern Labrador that is called the Caribou House, *ah-tee-which-oo-ap*, where the chief of all the deer lives. It is here they believe the caribou spend the summer. As a result of the slaughter in former days there are great heaps of deer bones around Indian House Lake which have been commented on by all travellers in the region. The caribou smelled these bones, the Indians say, and were offended, so that they returned to the Caribou House and told the caribou god, who directed the chief of the caribou to take them into his mountain. Since then the caribou god has refused to let the herd come south, and as a result the Indians have been starved out of their interior homes. To-day they are extremely careful in observing all the varied rites pertaining to the caribou, and thus hope to appease the anger of the god.

[1] The Indian terms used are in the Davis Inlet band dialect which is intermediate between that of the Barren Ground and the Northwest River peoples. The sounds are given according to English usage to aid the general reader. The Algonkian languages are difficult and can only be rendered accurately by the use of complex phonetic symbols.

The probable explanation of this interesting myth seems to lie either in the fact that the main herd in the north has ceased its annual southern migration or that it has been exterminated. Lucien M. Turner comments on the great slaughter of caribou in the Ungava district in 1882, but states that at that time their numbers did not seem to be decreasing.[2] However, in 1905, Mrs. Hubbard noted the rapid decrease in the migrating herds due she believed to excessive killing and large forest fires.[3] The complete cessation of this migration across Indian House Lake seems to have come about in 1916, when the Barren Ground people deserted the Indian House Lake region to go to the coast. The above rather indicates that the caribou have been killed off, but there are other factors to be considered.

North and east of Indian House Lake is a tremendous stretch of barren grounds into which almost no one penetrates. The Indians can not live in this area because of the lack of trees, for they will not eat raw meat like the Eskimo and they use wood for nearly all their household and other equipment. Thus the true barren grounds are to them a very definite ecological barrier. The coastal Eskimo do not penetrate any very great distance inland on their hunting trips and are, moreover, so few in numbers since the occurrence of the influenza epidemic of 1918 that they can not have much effect on the region.[4] As a result the caribou occupying this vast range must have been very little molested by man. The Moravian missionaries all say that for many years caribou have been exceedingly numerous to the west of the mission stations at Okak and Hebron, the Eskimo killing all they wanted only a short distance from the coast. This was certainly the case in May, 1928, when I visited these stations. The people had an abundance of meat and reported many deer only a short distance inland. It remains a question how large these northern herds may be and whether they are actually a fringe of the great herd that formerly performed an annual southern migration. This interesting question might most effectively be settled by an airplane reconnaissance of the northeastern sector of Labrador.

[2] Ethnology of the Ungava District Hudson Bay Territory, 11th Ann. Rep. Bur. Amer. Ethnol., 1894, p. 280. About this time the western caribou herds shifted to the eastern slope of the Ungava peninsula. R. Flaherty, "The Belcher Islands of Hudson Bay, their discovery and exploration," Geog. Rev., vol. 5, no. 6, 1918, p. 454.

[3] A Woman's Way Through Labrador, 1908, pp. 166–170.

[4] It should also be noted that both Barren Ground and Davis Inlet bands at present include only 94 persons.

One fact seems certain and that is the abundance of caribou in the north and their extreme scarcity in the southern part of their former range.

At present a few scattered herds of caribou, ranging in number from a few individuals to forty or fifty, are to be found in the barren tablelands west of the coast between Nain and Hopedale. These herds seem to come toward the coast in winter and to move back into the interior in summer, but there is no north and south migration so far as the Indians have noticed. Such herds furnish food for the Barren Ground and Davis Inlet bands to-day. During my stay with the Davis Inlet band from January to April, 1928, about forty caribou were killed. These included a few individuals near the coast and two entire herds, one of thirty-two and one of six animals, killed some eighty miles northwest of Davis Inlet. All of these were females or young males. The old stags tend to keep by themselves and are less easily killed than the others. Each adult female of the large herd killed on February 17 contained one embryo about six inches long. Five of the six females killed on March 31 each contained one almost hairless but fully formed embryo, about one and a half feet long; the sixth female was immature. According to the Indians these embryos would have been born in May, which appears to be the usual time for dropping the young. At that time the does often go into timbered or bushy river-valleys.

Practically all caribou killed during the winter and spring had antlers of varying size. The younger males[5] and the females do not lose their horns until April; they bud again in May and attain full size by August. The old stags on the other hand are said to lose their antlers in December and begin growing them in May. The velvet is loose in August and the antlers clean by the last of September. The rut takes place in October at which time the stags are very bold, but, according to the Indians, will not attack man. The caribou suffer greatly from the mosquitoes that swarm in the summer, and the Indians often find individual animals standing on high hills with their defenceless hindquarters turned toward the breeze while they attempt to keep the insects from their faces with

[5] According to Ernest Thompson Seton the young males of the barren ground caribou (*Rangifer arcticus*) shed their horns a few weeks after the old males, while the young males of the woodland caribou (*Rangifer caribou*) carry theirs until spring (Lives of Game Animals, vol. 3, pp. 73, 103, 1927). However, after the first reference, Seton quotes Frank Russell as finding bulls with horns in March and April, 1894, near Coppermine River; observations which agree with those of Dr. R. M. Anderson. There thus seems to be no specific difference in this regard between barren ground and woodland caribou.

their fore legs. Such deer are not eaten, as the meat is infected by the swelling from mosquito bites. In winter the caribou travel slowly over the wind-blown barrens of the higher country. Occasionally in heavy snow they make a "yard" several hundred yards in diameter, in which a herd of ten or twelve may stay for several months.

In hunting caribou the Indians go up on the barren plateaus and from high hills search for the animals or their tracks. When these are seen they are followed, often with dog sleds, until the game is fairly close at hand. Then the dogs are secured, and the men, keeping carefully to leeward of the deer, creep as close as possible. One man fires at the farthest animal, whose fall tends to drive the other caribou toward the hunters. Each caribou that starts to lead the herd in succession is killed, and the deer, leaderless, are soon milling around in a circle, often doing so until all are killed. In summer the animals are stabbed with short deer spears from canoes while they are swimming across the lakes, or else are stalked much as in winter. The use of deer spears and snares, and the practice of driving the animals into a corral where they are clubbed, speared or shot with bow and arrow, are among the older aboriginal practices.

Next to the caribou, the black bear, called by the Naskapi *mésk-weh*, is a very important food animal which is quite common in the timbered river valleys. In the spring and summer of 1927 four hunters of the Davis Inlet band killed fourteen black bears, which was considered a smaller number than usual. These animals emerge from hibernation late in April or early in May, at which time they are very fat, although this condition is soon changed.[6] During the summer they are hunted along the river courses with rifles, but in winter, when the animals are comatose, they are often killed with a deer spear or knife. Nearly every old summer camp of the Naskapi is marked by bears' skulls set on posts, for these Indians perform many rites to appease the spirit of this important animal.

I could obtain no definite records of the so-called barren ground bear which Turner mentions as fairly common in a restricted part of the northeastern interior.[7] The Indians have a term *méh-ta-shue* for a brown bear, which in one of their legends is classed as fiercer than the black or white bear. When shown pictures of the various bear species they identified *méh-tah-shue* with both the grizzly and the brown or

[6] R. M. Anderson notes the same condition in the barren ground grizzly just after hibernation. See V. Stefansson, My Life with the Eskimo, 1913, p. 521.

[7] Lucien Turner, op. cit., pp. 174–175.

cinnamon phase of the black bear. The older people said that some sixty years ago three of these brown bears attacked some Indian women at Petiskapau Lake, but were all killed by a man with a muzzle loader. None of the informants saw the dead animals or their killer, but they had talked with the women. Petiskapau Lake is far south of the reputed range of the barren ground bear, and it seems probable that the animals referred to were representatives of the brown phase of the black bear (*Euarctos americanus*). Common tradition over most of North America has it that the brown or cinnamon phase of the black bear is more pugnacious than his normal kinsman. The verbal testimony acquired by Turner, Low, Wallace[8] and others, provides rather strong grounds for the belief in a "barren ground grizzly" in northeastern Labrador, but nearly all these accounts seem originally to have come from Indian sources. Now the Naskapi are closely related to the Cree in language and culture and have evidently been much influenced by them. The Cree know the true grizzly of the barren grounds and call him *mistaya*.[9] It is possible therefore that the Naskapi have carried over tales of this awe-inspiring animal and applied them to the cinnamon bear in Labrador.[10] None of the living Davis Inlet or Barren Ground people, who range from Ungava to Hamilton Inlet, have ever seen the animal they call *méh-tah-shue* or any sign of him. Considering the vast gap between the known range of the true grizzly in the north central barren grounds and that of the reputed barren ground grizzly (*Ursus richardsoni*)[11] in Labrador, it seems logical to identify this barren ground bear of Labrador with a somewhat aberrant brown phase of the black bear (*Euarctos americanus*), at least until more conclusive evidence comes to light.

The white or polar bear is called *wah-púsk-weh*, and is feared by the Indians equally because of his strangeness to them and his great strength. Some fifty years ago they say these animals were occasionally met with near Rigolet on Hamilton Inlet. Davis Inlet band informants had seen bear tracks, said to be a foot and a half long, in the snow some thirty miles up Flowers River west of Davis Inlet and occasionally on

[8] Dillon Wallace, after making inquiries concerning this barren ground bear, came to the conclusion that it had been exterminated. The Long Labrador Trail, 1908, pp. 236–237.

[9] Chamberlain, A. F., Significations of Certain Algonkian Animal Names, Amer. Anthrop., n.s., vol. 3, p. 670.

[10] Hudson Bay Company officers in Ungava differed in their opinion whether these brown bear skins were from a grizzly or a cinnamon bear. E. T. Seton, op. cit., vol. 2, pp. 86–87.

[11] So identified by Bangs, Mammals of Labrador, Amer. Nat., July, 1898, p. 500.

the coast in winter time. The animals are said to cross the country in Ungava, but none of the Indians talked with had actually seen them nor, so far as I could gather, did they wish to.

When the caribou are abundant, many wolves are seen in the interior, but of late both animals have been scarce. During the winter of 1927 and 1928, no sign of wolves had been seen by any of the Indians with whom I talked. The general term for wolf is *máy-hee-gun*, but three kinds are distinguished: The gray, the white and the black. Gray wolves are most common, often being seen in packs up to the number of ten. Occasionally black or white animals are seen in these packs. The white wolves are sometimes seen alone and are probably representatives of the Arctic wolf (*Canis tundrarum*).[12]

Through the activities of the fur trade the distribution of fur-bearing animals in Labrador is fairly well known. Three color phases of the red fox and two of the white fox occur here as elsewhere. The Indian name for fox is *ma-tchee-sué*, although each species and color phase has a descriptive name. These animals seem to be most common near the coast and are more often hunted than trapped by the Indians. In bad weather the hunter takes the animal's fresh trail and follows it steadily, perhaps all day, through the woods where the foxes retreat during windy snowy weather. Travelling easily on snowshoes, the hunter wears down the fox and eventually shoots him. The beaver, *miś-kweh*, has been killed on interior streams west of Hopedale, but is not known farther north. The fisher (*Martes pennanti*) is actually unknown to these people, although he figures in one of their myths as the constellation Ursa Major.

The wolverene, *kwee-whátch-you*, is very rare at present but is well known and greatly detested as a robber of traps and caches. In Naskapi mythology he plays a large and very libidinous rôle. No accounts of torturing this animal when captured, such as Turner describes, were secured.[13] The otter, *nít-sook*; marten, *wah-pis-tán*; mink, *áh-tsuk-ash*; and muskrat, *oh-tchésk*, are found throughout this region along the forested river valleys. The muskrat, according to the Indians, breeds twice a year, once in June and again in August. The Indians have only one name for weasel, *mé-tah-kwut*, but they say there are three kinds in their territory, a large, an intermediate, and a very small weasel. The latter suggests the least weasel (*Mustela rixosa*) which has not been

[12] Bangs, op. cit., p. 505. The black wolf is a color phase of the gray.
[13] Lucien Turner, op. cit., p. 281.

recorded from northern Labrador. Several Indians who had been as far south as Seven Islands knew the skunk, although it is not found farther north. It is an interesting commentary on both the similarity of widely separated Algonkian dialects, and the origin of the word Chicago, that every time I mentioned the name of that city the Indians were convulsed with laughter, because of its close approximation to *shuh-kók-weh*, their name for the skunk. Similarly the word Chicago is translated in the Sauk, Fox and Kickapoo languages as "place of the skunk."[14]

An animal, which would seem to be the woodchuck, was described by several Indians who had seen it near Northwest River post on Hamilton Inlet. This animal is said to be slightly larger than a muskrat and lives in a burrow, hibernating until March. The Indians called it *wee-néskw*, and the local whites "la cole," which would seem to be a French-Canadian term. The porcupine, *kók-weh*, is an important food animal to the Barren Ground band, as it is quite abundant in the timbered regions from Nain to Voisey's Bay. South from Voisey's Bay to Hopedale it seems to be quite scarce in the interior river valleys, although the environment seems even more favorable than to the north. The red squirrel is fairly common especially near the coast and is called *oh-phów-i-now-súk-i-sas;* the flying squirrel was not known to any of my informants.

The Davis Inlet band use the word *ah-póok-a-sheesh* as a generic term for mice. The white-footed mouse (*Peromyscus*) was the only species caught while I was with the Indians, for mice, which are said to be extremely numerous some years, were extremely scarce in 1927 and 1928. Their name for this species is *kás-i-nas-kwán-tit.* From pictures by Louis Agassiz Fuertes they identified the lemming (*Dicrostonyx*) and the meadow mouse (*Microtus*) by the same name *wit-sús-kwe.*[15] The picture of the red-backed mouse (*Clethrionomys*) was likewise identified as *á-pu-wish-ish*, and that of the rufous tree mouse (*Phenacomys*) as *an-i-suk-i-sash.*[16] The latter is of course an erroneous identification,

[14] Handbook of American Indians, Bull. 30, Bur. Amer. Ethnol., 1907, p. 258.

[15] According to Dr. R. M. Anderson, the Eskimos of the Mackenzie district have the same name for the tundra vole (*Microtus operarius*) and the brown lemming (*Lemmus trimucronatus*) at all seasons, and for the collared, banded, or fork-clawed lemming (*Dicrostonyx rubricatus*) when in summer pelage. The latter when in the white winter coat is considered as a different species (*quilanmiutaq*) which is supposed to fall from the sky in snowstorms. Letter of February 12, 1929.

[16] This name is very similar to the latter part of the Indian term for red squirrel.

as the tree-dwelling mice (*Phenacomys longicaudus* group) are known only from the humid coast belt of northern California and Oregon whereas the two Ungava forms of *Phenacomys* (*P. ungava ungava* Merriam, and *P. ungava crassus*, Bangs), have been taken in an almost treeless area. The Indian name may refer to some other species that occasionally leaves the ground. The shrew (*Sorex*) was called *tcéen-is-tóo-yapóok-a-dgish*. A small bat that they occasionally see in the spring as far north as Davis Inlet they call *oo-pów-ah-pook-a-dgish*.[17]

As a rule the Indian has a very accurate knowledge concerning the life habits of the animals he hunts, which is in a separate category from the mythological concepts he may also weave about them. Certain non-mythical theories adhered to by the Davis Inlet people are therefore rather surprising to the naturalist. According to native belief both sexes of the arctic hare, *mís-ta wáh-push*, and the snowshoe rabbit, *min-áskw wáh-push*, are capable of bearing young. They say that usually the females have their young in June and July but that this function is sometimes performed by the male rabbit. No informant questioned had ever found new-born rabbits in the nest, but they based their belief on the fact that several times male rabbits with developed mammary glands and milk secretions had been killed. The well known difficulty in determining the sex of rabbits may form the pseudo-logical basis for the native theory. Similarly, they say that the abnormal dwarf caribou called *mah-tákw ah-tée-hoos*, which they have occasionally seen and killed, are carried by the male caribou for six years in a skin sack attached to the belly. Then they are dropped fully developed and accompany the herd. Unlike the larger animals, these dwarf caribou are said never to have botfly holes in the skin.

Possibly more purely mythical and less rationally conceived is their belief in two kinds of huge otters said to live in certain large interior lakes. Two old men of the Davis Inlet band claimed to have seen one of these animals, called *wen-tsúk-ah-més-e-téy-oh*, in Seal Lake (on the Nauscaupee, not the Little Whale River drainage). The body was said to be blackish brown with white lower legs and feet, large ears, and the animal was of great size. It whistled *wheú-u-u*, on a low note, very much like the call of a quail, or so the Indians' rendition of the call sounded. This animal has not been seen for many years, but an old story tells of an Indian who killed the young of this species and was

[17] Bangs, op. cit., p. 498, gives no record of bats north of Natashkwan and Lake Mistassini.

pursued by the mother otter who could swim under land as well as water. According to the story, she killed the man who destroyed her young, but his companion escaped to tell about it. The other mythical otter is called *mis-in-tsuk*, being about ten feet long and built almost exactly like a seal. It is said not to be dangerous unless attacked. One Davis Inlet man claims to have seen this animal in *atcagon napeesh* or Little Seal Lake (a short distance northeast of Seal Lake). Since harbor seals (*Phoca vitulina*) are fairly common in these lakes,[18] it seems probable that the Indians have combined the characteristics of seal and otter into this mythical conception. They have often killed seals there, but no one has ever killed one of these giant otters. The Naskapi tend to people the lonely and desolate reaches of the interior with many malevolent and supernatural beings, but all of these, with the above exceptions, are anthropomorphic in character.

Field Museum of Natural History, Chicago, Illinois.

NOTES ON SOME MAMMALS OF SOUTHERN MATTO GROSSO, BRAZIL

By Frederic Walter Miller

[*Plates 1–2*]

The following notes relating to a number of the larger mammals of southern Matto Grosso were all made in a more or less restricted area lying on the west bank of the Upper Paraguay at an approximate latitude of 16° south. The area in question (see map), being bordered on the east by this river, extends westward to the frontier of Bolivia, and from the Rio Jauru on the north, to Lake Gaiba on the south. It is admittedly but a tiny portion of the mighty state of Matto Grosso, yet it is an area of kingly size, covering hundreds of square miles. This is Descalvados, the property of a giant cattle company, of American and English ownership. Ranching has been carried on only in a comparatively limited section adjacent to the port of Descalvados, and the remainder lies, an unspoiled wilderness, with all the characteristic Matto Grossan fauna in striking abundance.

Beginning with Colonel Roosevelt's exploring expedition in 1913,

[18] See Bangs, op. cit., p. 499.

Descalvados has been the objective of numerous naturalists, all of whom have found it, under the administration of Mr. John Gordon Ramsay, to be almost a paradise; his hospitality and generous aid are of a quality seldom equaled and never excelled.

From September 7, 1925 until January 13, 1926, the South American Expedition of the Colorado Museum of Natural History, whose object was the collection of habitat group material for exhibition in the new James Memorial addition to that institution, was engaged in this field. Also from April 28 to July 26, 1928, the area was revisited and similar work was carried on. These two expeditions were organized and conducted under the direction of Mr. J. D. Figgins, Director of the Museum. The personnel of the first party included F. E. D'Amour, F. G. Brandenburg and the writer; that of the second, J. D. Figgins and the writer.

The necessity of securing adequate specimens, accessories and studies for the proposed groups of birds and mammals prohibited any detailed faunal investigations, and while the present paper may give a fair summation of the larger species it is not intended as a mammal list, and relates only to the species indicated.

Excepting the rugged, rocky hills at its southern end, and occasional isolated ones scattered about, Descalvados is a level plain only slightly elevated above the Paraguay river, which with a seasonal fluctuation of 12 to 15 feet, floods great areas during periods of high water.

Because of its lack of elevation no definite drainage system has been developed, and the water accumulating from the heavy seasonal rains and from the river's flooding occupies the depressions for nearly nine months of the year, forming swamps, *resantes*, and *riachos* of a more or less permanent character. In November, at the end of the dry season, which begins in June, water may become very scarce, a condition that exists only for a short period, as, with the approach of the rains, surface water is renewed.

While as a whole the area is typical of the *pantanal* region of the Paraguay basin, several well defined habitats occur. Pantanal and dense matt alternate in parts, while in others, as on most of the elevated ground, high jungle of rather limited extent is found. Inland, much of the country is *chapadaõ*, dry, grassy savannas dotted with scattered trees and thick, brushy groves; the latter being known as *capons*.

Low, meandering, sandy ridges, obviously old shore lines remaining from some earlier period, are found traversing much of the level ground. The *chapadaõ* is faunally distinct, being characterized by such savanna types as the pampa deer (*Blastocerus b. campestris*) and the Brazilian ostrich (*Rhea a. intermedia*).

On the map are roughly indicated collecting stations occupied during our work. It was our custom to outfit at the village of Descalvados

FIG. 1. DESCALVADOS, THE GREAT CATTLE RANCH WHERE THE EXPLORATIONS OF THE COLORADO MUSEUM OF NATURAL HISTORY WERE CARRIED ON

with ox-cart and saddle horses for trips of a month or six weeks duration, returning at the end of such intervals for renewal of supplies. The place

names used on the map refer to a general locality rather than some particular spot. Some, however, are well known camp grounds, while others are the sites of old corrals formerly used in capturing the wild cattle that abounded in certain sections during the early and more romantic history of Descalvados.

It is a pleasure to express again both the Museum's and my own personal gratitude to Mr. Ramsay for the abundant help he freely gave to make our work agreeable and successful. To the many others who also aided, acknowledgment has been made elsewhere.[1]

Procyon cancrivorus nigripes Mivart. Raccoon. Tracks of raccoons were occasionally seen but it was not until May 31, 1928 that an animal was encountered. On this date as we were riding across a flooded savanna, our dogs found a female on the ground in a small *capon* which rose like an island in the sea of grass. The raccoon fought and squalled with all the courage of its northern relatives, though hopelessly outnumbered by the dogs.

Nasua nasua solitaris Schintz. Two coatis, both of the red phase, were shot near Juda on September 20, 1925, and on December 11, 1925 a female accompanied by five little youngsters was seen in the heavy timber near Libertad. Coatis make interesting pets and many are seen in the homes of the natives.

Chrysocyon brachyurus (Illiger). Red Wolf. While by no means abundant, the red wolf is a fairly common animal in the Descalvados area, particularly in the *chapadaõ* lying to the west. Two specimens were taken, an adult female on November 11, 1925, and an adult male on May 28, 1928. Two others were observed, and a nearly complete skeleton was collected from the remains of one found entangled in the wire fence surrounding an abandoned *rosso* at Sucuri. The animal had passed its fore feet between the bottom and second strands and then, apparently, its body through the second and third, securing its feet by one complete twist of the wire. No doubt it had struggled fiercely for the carnassial teeth were shattered and the heavy gauge wire was deeply cut.

The Indians report that two is the usual number of young and that these are born in a nest concealed in the thick of the matt. Fruit is said to compose a large part of their diet and I was told that during the period of ripening figs they will return night after night to feast on the fallen fruit under some favored tree. The stomach of the female taken was empty; that of the male contained seven seeds of the cumbarú tree, and the feet and tarsi of a small passerine bird the size of a sparrow. The seeds of the cumbarú tree are, roughly, an inch in diameter and a quarter of an inch thick, and are thinly covered with a dry mealy pulp. The wolf is also said to prey to considerable extent on small armadillos, frequently

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[1] Report of the Colorado Museum of Natural History 1925–1926 and 1928. Denver, Colorado.

In the preparation of the present notes, I have received assistance from Mr. Colin C. Sanborn and Mr. G. S. Miller, Jr., in arranging and identifying some of the doubtful forms.

digging them out, but in view of the digging power of the latter this seems questionable.

On November 2, 1925 one was seen hunting through a small, jungle-enclosed savanna; where it was pouncing about stiff legged on a zig-zag course after the fashion of a mouse-hunting fox. No doubt the red wolf finds a large share of its sustenance in this fashion, for its long legs surely give it a great advantage over any small creature encountered in the high grass.

Felis ramsayi new name.[2] Jaguar. The name *Felis ramsayi* is here proposed as a substitute for *Felis paraguensis* Hollister (1914), which I regard as preoccupied by (*Felis*) *Panthera paragayensis* Oken (1816). Allen 1916, (Bul. Am. Mus. Nat. Hist., vol. XXXV, p. 578) while not proposing a new name at that time, discussed the question as follows; "The name *Panthera paraguensis* (referring to *Felis paraguensis* Hollister, Proc. U. S. Nat. Mus. vol. 48, pp. 169–170, 1914) is here adopted provisionally, in view of the earlier *Panthera paragayensis* Oken (1816), given to an ocelot. Oken in his 'Lehrbuch der Naturgeschichte' (dritter Theil, zweite Abtheilung) consistently employed "Paragay" for Paraguay, and in using it as the basis of specific names added the suffix *-ensis*, giving the form *paragayensis*, instead of taking "Paraguay" for the stem. . . . Both names are etymologically identical."

Felis ramsayi, the largest member of the jaguar group, is fairly abundant in the area and numbers of skins are brought in by the Indians for sale. They are distributed over a wide variety of habitat, but show a decided preference for well watered localities. Along the river they are sometimes seen on the banks from the decks of passing launches and less frequently swimming the channel. During our field work we saw considerable evidence of their presence in the way of abandoned kills and other sign. Besides the three taken we pursued several others which for various reasons escaped.

A female secured near Tamandua, September 11, 1925, contained a single embryo about six inches long; I have been informed that the jaguar, like the puma, has no definite breeding season.

Alligators seem to comprise a large element in their food supply, and with the exception of a wild calf, a wild bull and a swamp deer, they were the only kills found which could be definitely attributed to this animal. At certain periods alligators are found wandering far from deep water and at such times become easy prey. On two occasions we found the remains of three that had been killed within a few feet of each other. All those examined bore marks of the jaguar's teeth on the base of the head and skull and had been opened along the belly.

When a kill has been made the jaguar often remains with it for a considerable period, alternately eating and sleeping and, should its quarry be of large size, this may become a matter of days. The black vultures which are everywhere abundant keep a watchful eye on the big cat's activities and are quick to find its kills. The sight of a flock of vultures patiently perched in a tree is an almost sure sign that a jaguar is close by with a quarry it is not yet ready to abandon to them.

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[2] Named for John Gordon Ramsay, of Descalvados, Matto Grosso, Brazil; whose six specimens of this jaguar donated to to the Roosevelt Expedition were among the first representatives of the race to reach the hands of a naturalist.

The usual mode of hunting the jaguar is with dogs trained for the purpose. Despite the fact that none of the three collected was treed, I am convinced that practically all take to trees when pursued by dogs.

In Matto Grosso one hears frequent accounts of fatalities that occur on jaguar hunts. At Corumbá in August, 1925, there was said to be a man in the hospital recovering from lacerations received from a jaguar, and at Sal Obra, a little station on the Nor Ouste R. R. just east of the Paraguay River, we saw, on April 19, 1928, the fresh skin of a jaguar that had mauled one of his pursuers so badly that the man died. However, it is noticeable that all such incidents occur in the case of the poorly armed native, and the jaguar cannot be considered dangerous to the hunter who is properly equipped.

The jaguar spear, which is much used in hunting them in other parts of Matto Grosso, is seldom seen about Descalvados. In using it the hunter's object is to infuriate the beast into charging, when the butt of the spear is rested on the ground and the head so manipulated that the jaguar, as it leaps at its tormenter, is cleverly permitted to impale itself. The least that can be said of this method is that it is truly sporting.

Felis pardalis brasiliensis (Oken). Ocelot. Ocelots, from reports, are fairly common and well distributed and a goodly number of skins are sold each year at Descalvados. A fine male was shot from the branches of a fig tree near Tuyuyu on November 27, 1925, and two other specimens were brought in by Indian hunters. The Indians report the ocelot as preying extensively on birds; even successfully stalking and killing the rhea.

Felis concolor concolor (Linné). Brazilian Puma. It seems likely that future work will prove the puma of the upper Paraguay to be separable from that of southeastern Brazil, which has been assumed to be typical *concolor*.

In our series of three skins and skulls there are two males and one female. The skins are all remarkably alike in coloration, having a broad dorsal band of dull red, extending from the crown to the tail. The skull of a male taken November 25, 1925 agrees well in size with an adult male of true *concolor*, from Saõ Paulo, Brazil, cited by Merriam in his "Preliminary Revision" of the group.[3]

Pumas are fairly common but judging from the number of skins brought in for sale at Descalvados they do not equal the jaguar by one to two. Their preference in habitat seems to be for the more open and drier portions of the camp particularly in the vicinity of the low, sandy, openly wooded ridges which are of frequent occurrence in some parts.

On November 25, 1925, while hunting with dogs, we picked up a puma's track which we soon followed to its kill of the previous night, a young buck pampa deer, (*Blastocerus b. campestris*) and a short time later secured the beast, an adult male, at no great distance. Another male taken December 1, 1928, had eaten a small ant-eater (*Tamandua t. chapadensis*). On May 29, 1928 we found two recent kills, consisting of a doe brocket (*Mazama simplicicornis*), and a hen ostrich. The two kills were about thirty hours old and apparently had been made within an hour or two of each other. The two bodies lay near the point of a low ridge grown with scrubby trees. Both had been partially eaten and left

[3] C. H. Merriam, 1901. Proc. Wash. Acad. Sciences. Vol. 111, pp. 577–600.

to the buzzards. Tracks in the loose, sandy soil proved it to be the work of a large individual, probably a male, who after feeding had made for a nearby water hole to drink and rest, the outline of its body being plainly visible in the matted grass. A female taken December 10, 1925, contained two small embryos. Local information indicates that this is the usual number of young and that they are born at any time of the year without respect to season.

The skin of the puma is of little value commercially, bringing only two or three dollars, (15 or 20 milreis). It is strong and durable and many are used locally for making sandal soles.

Felis pajeros braccatus (Cope). Bush Cat. A single specimen of this rare cat which has been identified by Mr. G. S. Miller, Jr. of the U. S. National Museum, is in the collection. The specimen was brought in, in the flesh, to our camp west of Lagoona, by an Indian visitor on November 29, 1925. The man's dogs had found and killed it in the *chapadaõ* lying between our camp and the Bororo village at Lagoona.

In coloration it agrees well with the redescription of the type given by Allen[4] thus bearing out his judgment that *braccatus* is a legitimate race and not a dark melanistic phase of *pajeros*. Nothing was learned of its habits or distribution other than the Indians report of its being of rare occurrence. Its weakly-clawed feet suggest that it is largely terrestrial and not adept at tree climbing. The stomach of our specimen, a male, was empty.

Felis yagouaroundi yagouaroundi (Fischer). Two specimens a male and female, both representing the gray phase of this interesting cat, are in the collection. One was treed on January 6, 1926 by our dogs while hunting jaguars, and the other was secured on June 20, 1928 at Acurizal by Mr. Ramsay and presented by him to the Museum.

Callithrix argentata melanura (E. Geoffroy). Marmoset. Four specimens of this interesting little marmoset, which is rare in the locality, were taken.

On November 4, 1925, while hunting deer near Sucuri, my attention was drawn to a little buck pampa, standing in the open savanna at one side of a small *capon*. His interest was equally divided between my approach and something hidden from me behind the *capon*. Taking the tip I ignored the deer and hurried around the opposite end, finding a little party of these marmosets making off as best they could through the long grass. One was secured, and the remainder, reaching a straggling belt of timber, escaped.

In the heavy timber clothing the Bahia Pedra hills they were found also and three specimens were collected there on November 23, 1925.

Alouatta caraya (Humboldt). Black Howler. As we traveled up river from Corumbá late in August, 1925, black howlers were occasionally seen in the early morning moving among the branches of the timber bordering the river. Inland they were found in a number of localities where there was jungle of sufficient extent to suit their needs.

During 1925 they were common on Sao Joã hill a short distance north of Descalvados, and also directly across the river. These localities were found deserted in May and June, 1928, and it seems likely that the howlers perform seasonal migrations of a more or less local character.

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[4] Allen, J. A., Bul. Amer. Mus. Nat. Hist., 1919, Vol. XLI, pp. 376–380.

In August and September, 1925, many of the females were carrying tiny young which clung tightly to the long hair at their breasts. By October all young noted seemed capable of caring for themselves.

The full throated chorus of the black howler, rising and falling on the tropical air, is one of the most characteristic and inspiring of jungle sounds. Early morning and evening are the favored hours for these performances, though they are occasionally heard at mid-day, if the sky is overcast by an approaching storm.

Urosciurus langsdorffii urucumus (Allen). Squirrel. Two specimens of this squirrel were taken near Bahia Piedra, November 23, 1925. They were not common and this is the only locality at which they were noted.

Coendou centralis Thomas. Brazilian Porcupine. A native hunter brought in the remains of a porcupine to Descalvados on December 29, 1925, and on June 15, 1928, the skin of one was purchased from another hunter. Both had been killed in the timber along the river, a short distance from Descalvados. They are reported as uncommon.

Hydrochoerus hydrochoeris hydrochoeris (Linné). Capybara. The capybara, largest of rodents, is one of the interesting mammals that is suffering from recent developments in the market for South American pelts. In the past three years there has been a noticeable decrease in their numbers on the upper Paraguay. They are nocturnal, but not strictly so, and where not molested they are quite active in the early morning and late afternoon. In 1925–26 we found them abundant along the river, its tributary *riachos* and wherever there was sufficient water in the *pantanals* to suit their needs. In late August, 1925, as we came up river by launch from Corumbá we saw numerous individuals and occasional small parties on the banks. Two were shot by our crew and brought aboard for food. The meat has a pronounced flavor and I did not find it palatable. Along the *riacho* at Aguas Verde where we were camped from September 30 to October 17, 1925, they were very common and in the evening small bands would leave cover and forage out onto the open savanna for some distance. All of our series of 12 individuals were taken at this locality on the foregoing dates. They were most often encountered just before sunset, associated in little groups of both sexes, many of the females being accompanied by young a month or two old. On the afternoon of October 8, I met such a band at an open spot along the bank of the *riacho*. As soon as I sighted them I dropped on my heels and remained motionless. They were perhaps eighty yards away and approached in leisurely fashion. When half the intervening distance had been covered they seemed first to notice my presence, and, detecting something unusual, turned at right angles and walked slowly out into the water, which was choked with aquatic vegetation, gradually submerging until all were out of sight. After I had waited twenty minutes a male, pursued by another and larger one, rushed out of the water, careened madly about for a few seconds and then pursuer and pursued disappeared again in deep water. All was quiet for ten minutes more, when slowly and without noise the animals reappeared in the same unhurried manner on the far shore and resumed their promenade.

On another occasion I found a female and five young under the overhanging limbs of a thicket bordering the water's edge. They dashed into the *riacho*, the female diving at once, but the young, seemingly confused, were slower and I shot three, two of which were immediately snapped up by lurking alligators before

I could recover them. As I sat on the bank skinning the remaining young, a big adult came from the thicket behind me, and, pausing at the waters edge, squatted on its "hunkers" and barked at me. I kept motionless as long as my attendant swarms of mosquitoes would permit, and when at last I was forced to brush them from my eyes, the capybara leaped noisily into the water; but it was with some satisfaction that I noted that its ears had been kept twitching by a similar swarm during the entire time.

Alligators and the big water constrictors are probably their most dangerous enemies, after man. The former are especially aggressive, and being everywhere abundant within the capybaras' range, must account for many, particularly the young.

Pecari tajacu tajacu (Linné). Collared Peccary. Collared peccaries were found in occasional small bands, numbering up to a dozen individuals. We saw no evidence of large herds such as they are said to form in other parts of tropical America, or as were noted in the case of the white-lipped peccary.

The usual mode of hunting this peccary is with dogs that pursue and hold them until the arrival of the hunter. When brought to bay they back up against an ant hill or into a thicket of cat-claw and fight desperately, being capable of inflicting severe wounds, as they sometimes do, on inexperienced dogs. To me, it seemed quite strange to find them living in burrows, but such was the case, and in such burrows, or the occasional excavations of the giant armadillo, they sought refuge whenever possible. Burrows that I took to be of their own construction were always placed at the roots of a fallen tree, or similar spot, where a natural cavity occurred that could be enlarged with the minimum effort. On November 2, 1928, I found two newly born young at the mouth of their home. Their cries attracted the mother who, on my arrival, was out of sight in a nearby thicket. She made a desperate effort to rejoin them and I shot her. The two young, obviously but a few hours old, had their eyes open and, though a bit unsteady on their legs, nearly succeeded in escaping. The burrow in this case was dug among a tangle of roots and no doubt was originally the work of a giant armadillo. It was about eighteen inches in diameter and descended at an abrupt angle.

Tayassu pecari pecari (Link). White-lipped Peccary. The white-lipped peccary is not an abundant animal in the Descalvados area, and was encountered but twice in the course of our work. The first meeting took place on September 24, 1925, near the southern boundary of the area, when a herd of eight or ten individuals was found feeding in the open marshy ground bordering a thick patch of jungle. From these we collected a female that had been accompanied by two young a day or two old; one of these we succeeded in capturing alive. The second encounter took place near the Bolivian frontier on December 11, 1925. In company with an Indian hunter I had followed the trail of a large band for several hours, finally sighting them in a large, fairly open savanna. Being mounted, it was an easy task for me to overtake them. As we galloped up, the bulk of the herd, which numbered at least two hundred individuals, gathered in a compact mass among some scattered bushes and low growing trees. They kept up a constant rattling of their tusks and a low eerie moaning. Occasional little parties charged out at us but these our horses easily evaded. The decided aggressiveness of these animals was very apparent and the repeated warnings from my hunter that I should not dismount, were hardly needed. It was also interesting

to note that our dogs, which were accustomed to hunting the collared peccary, refused to approach within several hundred yards.

Eight specimens were collected without causing any great alarm among the remainder, who left the spot only after we had retired some distance. They then made off at a good pace and, following them, we caught two wobbly legged youngsters who had not been able to keep up. Young white-lipped peccaries are easily tamed and make interesting pets. Among the three kept by us there was a considerable difference in temperament. The first was a little female, extremely affectionate, and she became absolutely desolated when left alone. During the two or three weeks we had her in camp with us she slept each night snuggled up close to one of us on the floor of the tent. On our return to Descalvados we left 'Ed,' as we had named her, there, and she became a great pet about the house. One of the house dogs had given birth to a litter of puppies a short time previous and 'Ed' adopted herself into this family; the mother, after some misgivings, permitting her to nurse along with the puppies. The other two little pigs, having themselves for company, sought less for that of humans, and while thoroughly tame, never overcame a certain wildness. When suddenly touched they would whirl and slash savagely with their little tusks. 'Ed' died at the age of six months from digestive troubles, and the other two, becoming rather vicious with approaching maturity, were finally returned to their native jungle.

Blastocerus dichotomus (Illiger). Swamp Deer. The favored habitat of the big *ciervo* is the papyrus grown *pantanal*, neighboring the river, though they are by no means confined to it, and are found wherever marshland and cover occur to their liking. In the dry season they are necessarily more restricted in range, and during the wet period and the consequent inundation of large areas they become widely scattered. We seldom found more than two individuals together, although occasional family groups of does and young animals were seen. The bucks, except in the mating season, seem solitary.

The swamp deer is particularly confiding in its attitude toward man, so much so, that they seem positively stupid, and, as a result, they are rare in localities where much hunting is done. I have many times ridden directly to within twenty or thirty yards of an individual. Once a mated pair walked leisurely and unconcernedly through our camp, and at another time a buck, doe and yearling fawn passed within fifty yards of the tents, their progress unhurried by a volley from our Indians' forty-fours. They are frequently shot from the decks of the launches that ply the river between Corumbá and Saõ Luis.

When alarmed the animals elevate the tail in characteristic deer fashion, and bound off in a laborious rockety manner, which however, is very effective over swampy ground. When the footing is good they are comparatively slow.

The antlers of the bucks are regular and well formed. They are dichotomous, heavy and massive. Four is the usual number of points to the side. One bushy head in the collection has eight to the side. Our largest measure 600 mm. along the beam with a spread of 510 mm. Bucks were taken with fully developed antlers during every month we were in the field, that is, May, June and July, and again from September to the following January. One was secured in velvet, on November 16, 1925, and a young buck taken November 6, 1925 had just shed its antlers. Fawns were seen on December 7, 1925 and January 16, 1926. Females in milk were taken in October and November 1925, and these, no doubt, had fawns hidden close by.

The skin of the swamp deer is regularly sold, the greater portion from Matto Grosso going to the hide markets in Montevideo. The trivial amount they bring the hunter hardly pays for ammunition, nevertheless thousands are shipped annually.

Blastocerus bezoarticus campestris (F. Cuvier). Pampa Deer. By far the most abundant and typical game mammal in the chapadaõ is the little pampa deer. They are at home on the great grassy savanna with its scattering growth of low scrubby trees, especially favoring localities where there have been recent grass fires and the newly sprung forage is green and succulent. They are fleet of foot and graceful in all their movements, bounding with ease over bushes and other obstructions of considerable height. In open flight they frequently leap high into the air after the fashion of the "sky hop" of the jack rabbit, and, no doubt for a similar purpose—increased observation.

In May, June and July we found this deer singly and in pairs. Later in September they were occasionally seen in small bands and as the season progressed this became more noticeable and often a dozen or more were found in company.

The bucks shed their antlers in May, the new ones appearing immediately after and growing rapidly so that by September nearly all are mature and cleaned of velvet. Our record set measures 505 mm. along the beam and has a spread of 256 mm.

Early in September, 1925, we made a trip southward to the vicinity of Lake Uberaba, passing through great stretches of ideal deer country. Many were observed but all were adults. Returning a month later over our out-bound trail, we found the same area literally teeming with deer, and every doe accompanied by a fawn. Such was the similarity in the size of the fawns that it seemed that all must have been dropped on a single night. On December 4, 1925 at another locality near the Bolivian frontier a deer count on a two hour ride numbered twenty-six of all ages, and it is likely an equal number escaped observation. However such numbers are found rarely, and much country that is from all appearances equally desirable is practically tenantless.

These deer have no metatarsal glands, but from the sac between the phalanges of the hind feet is exuded a powerful scent, which is quite noticeable about recently vacated bed grounds or spots from which the deer have been frightened by the advent of an intruder.

The meat of the pampa deer is fine-grained and well flavored, though a trifle dry. The hides are thin and delicate; stretched and dried many of them find their way to the markets in Montevideo each year.

On several occasions we caught and kept fawns of this species as pets. They are easily tamed and became quite friendly, but as we found it difficult to obtain the proper food required by their tender age our experiments usually ended in failure.

Mazama rufa rufa (Illiger). Red Brocket. In the dense, almost impenetrable jungle that borders the river in many places the big red brocket is frequently found. It also occurs inland, though rather sparingly.

On January 8, 1926, I collected a male with horns in velvet. On skinning the animal we discovered the flesh on the flank back of the left shoulder to be badly discolored and "blistery." We were in need of the animal for food, but though it appeared in healthy condition otherwise my two Indian companions refused to eat it, saying that if we did we should become affected in a similar fashion.

That these deer are good swimmers and take to the water was readily demonstrated by one seen crossing the river near Descalvados on July 15, 1928. The animal entered the water from the west bank at a point where the river is from 350 to 400 yards wide. It struck out boldly and made good headway though naturally drifting some with the current. Landing on the far shore it rested for a moment, re-entered the water, and continued on down stream, keeping close to the bank. Rounding a bend it was met by a canoe load of Indians who shot it and brought it ashore. It was a female and contained a single embryo that would have been born within the next few days.

Mazama simplicicornis simplicicornis (Illiger). The little brown brocket is a denizen of thick cover, spending the day in its shelter. In the late evening it sometimes forages out into the open, and belated individuals are occasionally found abroad in the hours of early morning.

Males with mature antlers were taken in May, June, November and December. Another individual secured in December was in velvet. A fawn of the year, secured at Sucuri on October 29, 1925, was just losing its spots.

Tapirus terrestris terrestris (Linné). Tapir. Tapirs are usually reported as favoring river banks or similar well watered localities where they can escape pursuit by diving. In the Descalvados region we found the reverse to be true and most of our series of seven were taken in areas of scant moisture, some in fact so dry that it was with difficulty we found sufficient water for camp use.

In the month of September, 1925, we were camped near Juda (see map) and in that general vicinity secured four. The first, a male, was brought to bay in the heart of a drying papyrus by our dogs while hunting jaguars. A few days later a mated pair were collected as they crossed an opening in a patch of heavy timber. The last from this locality was encountered traveling in the open along the edge of a strip of jungle.

While stalking deer near Sucuri, October 22, 1925, I saw a young of the same year cross an open savanna, a quarter of a mile distant, but was unable to secure it. At the same locality a few days later, hunting with an Indian companion, I saw two tapirs enter a dry *resante* grown up to a tangle of vines and wild cotton. We hunted diligently through the immediate surroundings but failed to start them. However, on returning on the far side of the *resante* several hours later, we found both sleeping in the shade of an isolated tree.

Tapir sign was quite abundant at Sucuri, particularly on the low sandy ridges which the natives flatteringly refer to as cordilleras, despite the fact that the highest does not rise ten feet above the surrounding level. The tapirs were apparently attracted there by the ripening fruit of a tree, the name of which I did not learn. The fruit in size and shape somewhat resembles an apricot. It occurs commonly on the ridges and the droppings of the tapir in those localities were largely composed of its hard pits.

Near Lagoona on November 13, 1925 my Indian hunter and I ran down a medium sized male with our horses. The country at this spot was of the savanna type thickly dotted with *capons* and small patches of jungle. The two of us by cutting corners were able to keep the tapir in sight and after a run of a mile or two had him completely winded.

The eyesight of the tapirs seems bad, and when alarmed they crash blindly off occasionally striking trees with sufficient force to knock themselves down.

To the Bororó Indians, who compose the bulk of the local population, the tapir is, with the capybara, a taboo animal or "*santo*," and is never killed by them. The Bororó's respect, however, is rather flexible and they have but few scruples in aiding in its pursuit. I have been told of their lassoing and tying the creature to a tree to await the arrival of some other person, who, not holding the beast in such high regard, would be willing to kill it.

A few tapir hides are used every year at Descalvados for making heavy leathers, but the animal is never sought for food.

Tamandua chapadensis Allen. Little Ant-eater. We found the little Ant-eater rather widely distributed, but not common. Two were seen high in the branches of a big piuva tree on January 9, 1926. A male and female were collected on May 30th and June 2nd, respectively. These two were both found curled up and asleep in the crowns of small trees

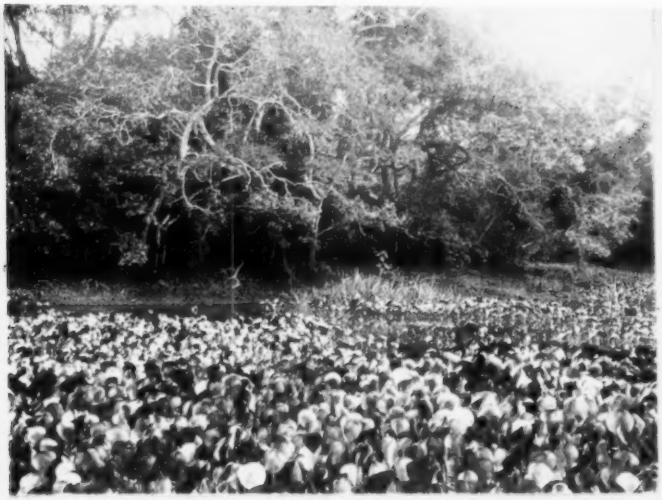
Myrmecophaga tridactyla tridactyla (Linné). Giant Ant-eater. Five specimens of the giant ant-eater were taken, two males, two females, and a juvenile female about a month old. All were found singly with the exception of a female taken January 2, 1926, which was carrying on her back the juvenile referred to. The youngster had secured a safe position on the back of its mother with its fore legs tightly clasped about her neck and seemed in no way to encumber her actions as she sought to escape in the dense matt. Another female, collected on December 6, 1925, contained a single small foetus.

Though these ant-eaters seem largely nocturnal, spending the daylight hours hidden away in dense cover of thorny palm and cat-claw, they are great wanderers. Their characteristic trails lead across the grassy savannas from one *capon* to another, and are a graphic record of their nightly travels. Often in hunting them shortly after daylight we would follow the trail of an individual several hours before coming on it asleep in the thick matt. Curiously, though the ant-eaters have a pronounced scent, dogs will readily pursue them on sight, but will not follow their spoor. When alarmed the ant-eater travels at a clumsy gallop, the big bushy tail being held slightly above the horizontal and swaying loosely from side to side. The fore legs and feet are kept rigid, lending the animal a somewhat mechanical appearance.

A male taken December 10, 1925 was badly scarred on one shoulder; the work, so our Indians said, of a jaguar. They also stated that out of respect to the ant-eater's powerful fore claws the jaguar seldom attacks it, and that such encounters often result fatally for both parties.

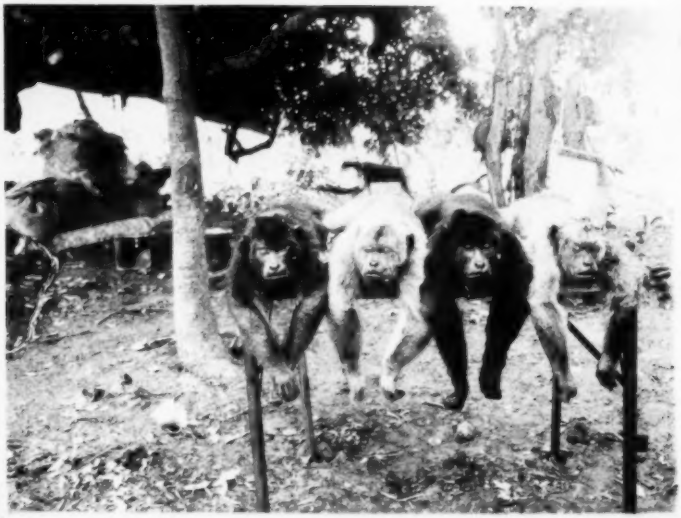
Priodontes giganteus (Desmarest). Giant Armadillo. Occasional unoccupied burrows of this huge armadillo were noted in the general vicinity of the Indian village at Lagoona. On December 13, 1925, a prepared skin was purchased from an Indian who had killed it a few days previously in that locality.

Colorado Museum, Denver, Colorado.



UPPER: TYPICAL RIACHO, HAUNT OF CAPYBARA, AND THE JUNGLE IN THE BACKGROUND THAT OF BLACK HOWLER AND BROWN BROCKET
LOWER: YOUNG MALE PAMPA DEER; NOVEMBER 4, 1925

UNIV. OF TORONTO



UPPER: BLACK HOWLERS, OCTOBER 11, 1925; THE LIGHT-COLORED ANIMALS ARE FEMALES

LOWER: BRAZILIAN PUMA, MALE; NOVEMBER 25, 1925

A BASSARISK AND A NEW MUSTELID FROM THE LATER TERTIARY OF CALIFORNIA

By E. Raymond Hall

Prof. Chester Stock and Mr. E. L. Furlong of the California Institute of Technology, knowing of the writer's interest in the families of smaller Carnivora, have kindly placed in his hands, for study, the material here described.

Bassariscus antiquus Matthew and Cook

Bassariscus antiquus Matthew and Cook, Bull. Amer. Mus. Nat. Hist., vol. 27, pp. 377–378, fig. 6, Sept. 3, 1909; Hall, Univ. California Publ. Bull. Dept. Geol. Sci., vol. 16, pp. 437–439, pl. 64, *a*, *b*, *m*, *n*, March 17, 1927.

Probassariscus antiquus, Merriam, Univ. California Publ. Bull. Dept. Geol. Sci., vol. 6, p. 248, figs. 21 *a–b*, Sept. 16, 1911; Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, p. 65, July 3, 1924.

Probassariscus antiquus matthewi Merriam, Univ. California Publ. Bull. Dept. Geol. Sci., vol. 6, pp. 246–248, figs. 21 *a–b*, Sept. 16, 1911; vol. 9, p. 176, Feb. 23, 1916.

Material.—No. 66, California Inst. Tech. Coll. Vert. Palaeo.; two fragments of left mandibular ramus, one bearing M_1, P_4 in part, and the alveoli of P_3, and the other comprising the angle and adjacent parts of the jaw; from same locality as the type specimen of *Brachypsalis angustidens*.

Remarks.—No. 66, as indicated by the comparative measurements given below, agrees closely with the two previously described specimens of this species. M_1 of *B. antiquus* may be distinguished from that of *B. sumichrasti* by the fact that the width of the talonid is less than one-half the length of the tooth and from that of any other species of the genus by the relative length of the talonid which is more than seven-tenths the length of the trigonid.

The two other known specimens come from Middle or Lower Miocene deposits; the type specimen from the Lower Snake Creek, *Merychippus paniensis* zone, of Western Nebraska, and the other from the Virgin Valley beds of northwestern Nevada. These two occurrences, together with the one here reported from the southern part of the San Joaquin Valley of California, indicate a geographic range for the species which approaches, in area, that of the Recent *Bassariscus astutus*, and which certainly is more extensive than that of the Recent *Bassariscus sumichrasti*.

It is worth noting that the only other known extinct species of the genus, *Bassariscus parvus* Hall (Univ. California Publ. Bull. Dept. Geol. Sci., vol. 16, p. 440, pl. 64, *f*, *i*, 1927) which comes from the Esmeralda formation of west-central Nevada, is, structurally, markedly more advanced than *B. antiquus*.

The structural features of *B. antiquus* (= subgenus *Probassariscus*) mark it as more primitive than any other species of the genus. It is regarded as being nearer, although not in, the line of descent of the subgenus *Bassariscus* (= *B. par-*

vus, B. astutus and *B. albipes* which latter probably is at most a subspecies of *B. astutus*) than the line of descent of the subgenus *Jentinkia*, which includes *B. sumichrasti*, the most primitive Recent species. For a review of the evidence on which these assumptions rest, see Hall, Univ. California Publ. Bull. Dept. Geol. Sci., vol. 16, no. 11, 1927, and Univ. California Publ. Zool., vol. 30, no. 3, 1926.

Since writing the above a right M_2 (no. 28501, Univ. California Coll. Vert. Palaeo.) of *Bassariscus* has come to hand from the Barstow Miocene, eleven miles northeast of Hinkley, San Bernardino County, California. This tooth, included among fossil rodent material collected in 1923 by Miss Annie M. Alexander and Miss Louise Kellogg at "Rodent Hill," agrees in relative proportions with the corresponding tooth of *Bassariscus sumichrasti* but in actual size more nearly resembles *B. antiquus*. The tooth is 5.3 mm. long and 3.2 mm. wide. Although not specifically determinate, this M_2 establishes a fifth locality record for fossil representatives of the genus *Bassariscus*.

TABLE 1

Measurements of M_1 of the three known specimens of Bassariscus antiquus

	NO. 12539, UNIV. CALIF. COLL. VERT. PALAEO., VIRGIN VALLEY BEDS, NEV.	NO. 66, CALIF. INST. TECH. COLL. VERT. PALAEO., KERN RIVER BEDS, CALIF.	NO. 13860, AM. MUS. NAT. HIST., SNAKE CREEK BEDS, NEB.
	mm.	mm.	mm.
M_1, length	7.5	7.5	7.5
M_1, length of talonid	3.2	3.2	3.2
M_1, length of trigonid	4.3	4.3	4.3
Ratio, length of trigonid to length of talonid	74.4	74.4	74.4
M_1, width of talonid	3.7	3.6	3.5
Ratio, width of talonid to length of tooth	49.3	48.0	46.7

Brachypsalis angustidens new species

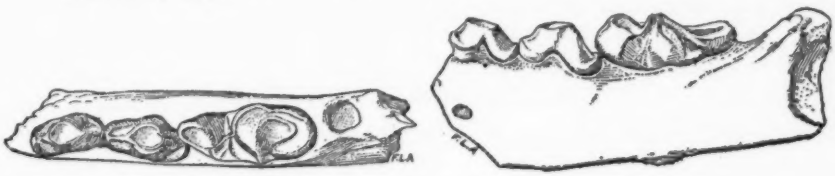
Type.—No. 44, California Inst. Tech. Coll. Vert. Palaeo.; fragment of left mandibular ramus bearing P_3, P_4, M_1 and the alveolus of M_2; from Kern River Pliocene, locality no. 49, California Inst. Tech. Coll. Vert. Palaeo., Kern River—Poso Creek divide approximately nine miles northeast of Bakersfield, Kern County, California, SE ¼ of Sec. 23, T. 28S, R. 28E, Mt. Diablo Base and Mer.

Diagnosis.—Size (see measurements below) one-sixth less than that of *Brachypsalis matutinus* Matthew; talonid of M_1 deeply (see fig. 1 A) basined; P_4 with incipient, posterior accessory cusp and strong anterior and posterior crests.

Comparison.—Selected points of difference from *B. matutinus* (as represented by description, measurements and figures given by Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, p. 133), in addition to smaller size, are: Relatively narrower M_1; P_4 with, rather than without, posterior accessory cusp.

Remarks.—The external part of the protoconid is broken away. Although the talonid of M_1 is much worn, it shows the external margin of the talonid to have been separated from the posterior margin of the protoconid by a distinct notch, and suggests that the internal margin of the talonid was without a distinct entoconid and was continuous with the posterior margin of the metaconid.

In addition to the presence of an incipient, posterior cusp, P_4 is strongly crested anteriorly and posteriorly and has a well developed heel on the posterior border and a smaller basal ledge anteriorly. P_3 is similarily crested anteriorly and posteriorly and has a well developed basal ledge anteriorly and posteriorly but lacks an accessory cusp.



A B

FIG. 1. A, OCCLUSAL VIEW AND B, LATERAL VIEW OF TYPE SPECIMEN OF BRACHYPSALIS ANGUSTIDENS

TABLE 2

Measurements of Brachypsalis angustidens

	mm.
Length of P_3 to M_1 (inclusive)	22.4
Length of P_3 and P_4	12.2
Length of P_3	5.7
Breadth of P_3	2.9
Length of P_4	6.8
Breadth of P_4	3.5
Length of M_1	11.2
Breadth of M_1	5.0
Length of talonid of M_1	3.6
Length of alveolus of M_2	3.4
Breadth of alveolus of M_2	2.8

Of the numerous described Tertiary mustelids known to the writer, *B. angustidens* appears to be structurally most closely related to *Brachypsalis matutinus* Matthew from the Lower Sheep Creek beds, Middle or Lower Miocene of western Nebraska. In a comparison with Matthew's (*loc. cit.*, fig. 32) line drawing of the lower jaw of *B. matutinus*, *B. angustidens* has a relatively longer talonid on M_1, a more complex construction of P_4 and, relative to M_1, probably a smaller M_2. The latter tooth in *B. angustidens* is, however, represented only by the alveolus. These differences would seem to indicate that *B. angustidens* was more advanced structurally, than *B. matutinus*. Also, the premolars appear to be less crowded in *B. angustidens*.

The generic reference of each of the two mentioned species is admittedly questionable. As treated by Matthew (*loc. cit.*, p. 131), the genus *Brachypsalis* embraces species differing widely in structural details. However, until we have more information about the type species of the genus, it seems best to place these several forms within a single genus. Because it resembles one of these, *B. angustidens* is provisionally placed in the genus *Brachypsalis*.

Berkeley, California.

THE FOOD OF THE SORICIDAE

By W. J. Hamilton, Jr.

While the food of moles has been made a subject of considerable study, that of the shrews has been quite neglected. This has been due, in large measure, to the difficulty in determining the stomach contents. More often than not the food is so well chewed that it is a difficult matter to determine what has been eaten. Often only fragments of chitin, perhaps an isopod leg, or simply a mass of partially digested flesh leave the investigator to conjecture on the possible food preferences of these animals.

For the past three years I have been making examinations of the stomach and intestinal tracts, from fresh and preserved material, of *Blarina brevicauda talpoides*, *Sorex cinereus cinereus*, *Sorex fumeus*, and *Sorex palustris albibarbis*. These have been taken in all sorts of habitats and I have specimens of the first named for every month in the year.

The method employed was to wash the contents of the stomach and alimentary tract into a large petri dish, separate the food with dissecting needles, and study under a low-powered binocular. Smaller parts were mounted on slides and determined with the aid of a compound microscope. When as much of the food as possible was determined, it was separated into piles and the percentage by bulk determined as accurately as possible.

FOOD OF BLARINA BREVICAUDA

General writers of natural history list the food of the short-tailed shrew as insects, worms, slugs, snails, mice and other small animals. Merriam (1886) states that Blarina subsists on beechnuts, earthworms,

insects, slugs, sowbugs and mice. Shull (1907) found that many beetles and their larvae, moth larvae, other insects and their pupae, earthworms and sowbugs, snails of the genus *Polygyra*, and meadow mice are taken as food. Babcock (1914) writing on the food of the short-tailed shrew, has condensed the writings of others on the food of this species, and finds that all are in general agreement on the food eaten. While most authors believe it to feed to a very limited extent on plant food, Babcock fed a shrew for fifty-two hours on rolled oats and the animal thrived very nicely on this diet. He also placed an assortment of twenty-one kinds of vegetables before the shrew and these were untouched for eleven hours.

SNAILS

Shull (1907) found the short-tailed shrew to be very fond of snails. His conclusions, stated briefly, are these:

a. *Blarina brevicauda* preys upon various snails of the genus *Polygyra*, at least in winter.

b. These snails are hoarded, and in general are moved to the surface of the ground as the temperature falls, and into the burrows as the temperature rises.

c. Empty shells are brought to the surface and not moved again into the burrow.

d. Empty shells not left at the surface are stored about the nests, along the burrow or in special chambers.

My own observations on this are meager. On Jan. 27, 1927 I found a heap of twelve *Polygyra* shells, all occupied, lying on five inches of snow. A tunnel led directly down from them. Twelve paces away another hole opened on the snow and two snails were deposited here. The temperature had been 12°F. the previous night and went down to −8°F. during the day. I did not remove the snails. The following day all the snails were removed. Repeated trips to the same locality failed to reveal the snails again.

In a swampy area near Ithaca, N. Y. locally known as the Rifle Range, small piles of snails were found during late February and early March, invariably with a tunnel leading down from them. The distance was too great for me to make daily trips so further notes were not secured. Frequently I have found snails with the whorls eaten away, particularly about stumps and decaying logs. At one time during the early spring I found a small pile of shells, numbering seven, in a little run traversing a sphagnum bog. No shrew was taken in this runway but it does not seem unlikely that this was the work of *Blarina*.

Shull lists five species of snails eaten by Blarina, in the order of their abundance: *Polygyra albolabris, Polygyra multilineata, Polygyra profunda, Polygyra fraterna* and *Polygyra thyroides.* Clench (1925) records *Pyramidula alternata, Omphalina cuprea, Polygyra albolabris, Polygyra zaleta* and *Polygyra thyroides.* All of these specimens had the first two whorls eaten out. In captivity, shrews take snails of this genus quite readily, and the big water snail, *Limnea,* is much enjoyed. That shrews will eat snails at seasons other than the winter and early spring is proven by finding the radula of these molluscs in the stomachs of summer and fall specimens.

MICE

Numerous observers have noted the apparent fondness for mice that shrews exhibit. Morden (1883) states that it took about ten minutes for a short-tailed shrew to overcome and kill a meadow mouse larger than itself. Merriam (1886) found an 11.2 gram shrew (this must have been an exceptionally small one) was half an hour in tiring and killing a 17 gram deer mouse. Babcock (1914) says it took twelve minutes for a shrew to kill a mouse after getting its first hold. He further adds that the shrew, which weighed 15 grams, captured and killed during the night a red-backed mouse weighing 29 grams and seemed uninjured after the encounter.

I have fed a good number of deer mice and house mice to shrews, likewise a few *Microtus.* After a heavy meal, and the shrews were fed to repletion, they usually paid little heed to live mice released in their quarters. On one occasion I placed a large house mouse, weighing 16 grams, in an aquarium with a shrew weighing 20.5 grams. The shrew immediately came out of the nest box and commenced to run about the aquarium. Its nose was held high and constantly twitching. When it passed close to the mouse it made two or three unsuccessful jumps at him, but finally succeeded in fastening itself to the mouse's tail. Here it clung tenaciously for over two minutes, the squeaking mouse dragging it about the enclosure, the shrew bracing its feet and tugging hard but always silent. The mouse finally freed itself, but the shrew quickly renewed its grip, this time attaching itself to the left shoulder of the mouse. The mouse tried hard to bite the shrew, but Blarina fought off this attack with its fore paws. When the mouse again freed itself, the shrew was quick to seize it over the frontals, just below the eyes. This at first did not appear to be a very effective grip, as the mouse continued to be quite vigorous. Its struggles soon became weaker, however, and

when the shrew released its grip and bit into the base of the brain, the rodent's struggles ceased. The end came fourteen minutes after the shrew secured its first grip on the mouse. The shrew was content to store the mouse in the sphagnum, and did not commence at once to eat his hard earned game.

Most of the mouse killings I observed follow this order. The shrew first grabbed the mouse by the tail, then changed its grip and endeavored to bite through the frontals. In some instances the shrew was close to an hour in catching a mouse, but never very long in killing it.

It is one matter to catch and kill a mouse in a small area as has been described, about 14 by 22 inches, and quite another matter to down a mouse in its natural haunts. But it is done, and Shull records finding a nest of *Blarina* composed entirely of the hair of *Microtus*, and also the dead bodies of this mouse packed in the soil about the retreats of *Blarina*.

Hahn (1908) speaking of *Blarina brevicauda carolinensis*, says:

"One day, while collecting along a railroad embankment, I heard a loud squeaking, and going to the spot I discovered a short-tailed shrew carrying away bodily a nearly grown *Microtus pinetorum*. The shrew became frightened at my approach and left its victim, which was about dead. The vole was the heavier of the two animals."

STOMACH ANALYSIS

Practically nothing is to be found in literature dealing with stomach examinations of shrews, such as is the case so frequently with moles. Shull examined 13 stomachs sent him by Seton (1909) and found earthworms in 8. This is a surprisingly larger proportion than my studies have shown. Other food was insects, isopods and flesh. In two other stomachs he examined, Shull found mouse remains in one.

In the past three years I have examined the alimentary tracts of 244 specimens of *Blarina brevicauda*. These have been taken in every month of the year and in a wide variety of places. Thus a fair average has been secured of the food eaten throughout the year, and the data are presented herewith.

It would be quite unnecessary to list all the stomach examinations individually. Diagram 1 shows readily the percentage by bulk of the various foods eaten. Insects, as has repeatedly been stated, lead the list, comprising almost one-half of the food. Plant material leads a poor second, but the large number of stomachs which contained vegetable matter was somewhat surprising and contradictory to the experience

of other authors. I have been careful not to include in this number all those that contained plant material, but only those which had enough in them to make me believe that this food had been taken intentionally.

Annelids were found in very few stomachs. While worms appear to be the chief food of the mole, only a small number are eaten by shrews,

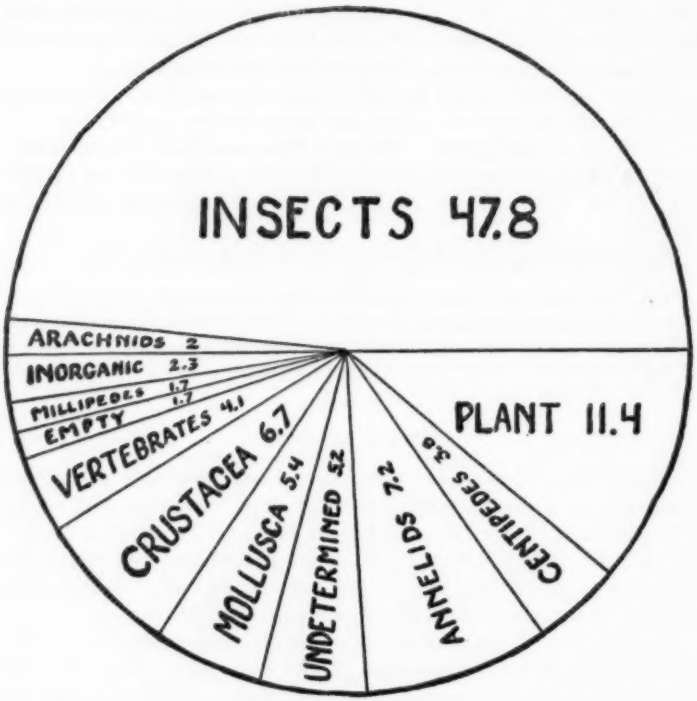


FIG. 1. STOMACH CONTENTS IN PERCENTAGE BY BULK OF 244 BLARINA

and these never constitute the greater bulk of the stomach contents. While worms are eaten readily enough in captivity, they appear to be rejected for more favorable forms in the wild state. A diet of snails is taken at most any time of the year, and as opportunity offers. Crustacea, of which sowbugs, *Oniscus* sp., make up the larger part, are eaten frequently. Of the vertebrates, only 4 stomachs contained mice

remains. This would indicate that while mice may be enjoyed, shrews apparently are not strong or quick enough to capture a healthy adult mouse very frequently. Bird remains were found in two stomachs, but in all likelihood they were crippled or dead specimens found by the shrew. Salamanders were found in 3 stomachs, two of which were taken in February.

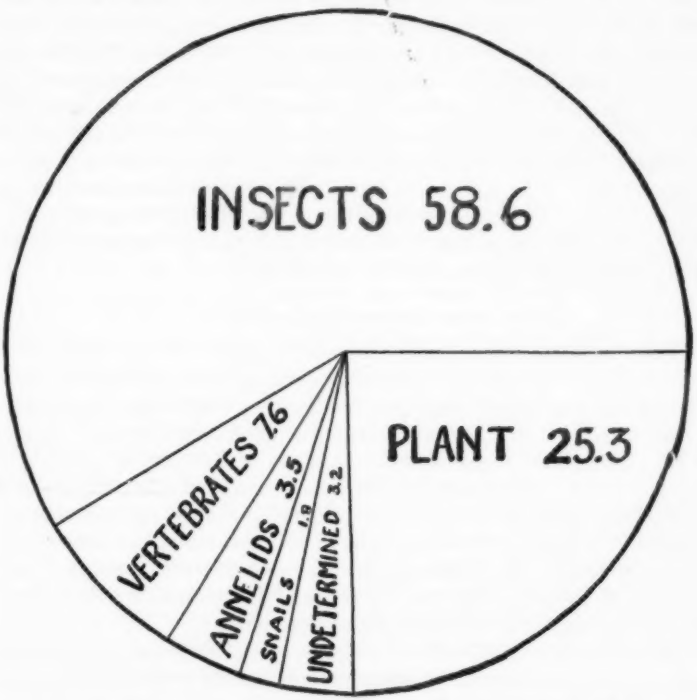


FIG. 2. STOMACH CONTENTS OF 66 BLARINA TAKEN DECEMBER 15 to MARCH 15

Centipedes, arachnids, millipedes, and inorganic matter, such as pebbles and sand, make up the rest. Not quite 2 per cent of the stomachs were empty, which indicates that Blarina feeds at all hours and frequently.

One can readily see how Blarina would experience little or no trouble in securing food during the warm months but what a problem it must be

to satisfy its appetite during the period of ice and snow, frozen ground and dormant life. Merriam thought that during the winter months Blarina must feed largely on the chrysalids and larvae of insects. Shull has pointed out the importance snails play in the winter fare of this diminutive animal. But snails are by no means abundant enough to satisfy the shrew at this season. Shrews are not known to hibernate. I have made examinations of 60 stomachs between December 15 and March 15, and list this in diagram 2. It is interesting to note that even in the dead of winter, with a temperature often below zero, Blarina eats a greater amount of insect food proportionately than in the summer. It is true that the food consists mostly of dormant beetles and pupa cases at this time, but these appear to please shrews as well as the softest cutworm. The shrews probably tunnel deeper in the winter months in quest of food. The salamander remains found in the stomachs of shrews taken in February would indicate this. Likewise, the large number of stomachs containing starchy plant remains at this time show the short-tailed shrew to be not impartial to plant food.

FOOD OF CAPTIVE BLARINA

Three captive shrews were under observation for not quite three months, and various foods were placed before them during this time, to determine if possible any predilection they might show for various organisms. A word about the manner of keeping captive shrews might be in place here, as so many have met with failure in attempts to keep these fascinating animals alive for any length of time. Aquariums were used, 14 by 22 inches, with several inches of moist sphagnum in the bottom. A smaller tin box was placed within this and the shrews were quick to build a nest of sphagnum. The aquaria were placed in a dark cool place, as bright light usually proved fatal to them in a short time. A constant supply of water was kept before them.

Whenever feasible, live food was presented. No definite times were set as a feeding schedule, but whenever opportunity presented I collected food and fed them.

Among the vertebrates, mice and birds were enjoyed. Brooks (1908) believes the short-tailed shrew guilty of eating nestlings and eggs. When the eggs of house sparrows were placed before them, the shrews paid no attention to them and the eggs were always left intact. On one occasion I placed a young house sparrow that could just fly in the aquarium with a large shrew. The flutterings and wing beats of the sparrow did not appear to alarm the shrew. The following day the bird

was picked clean of meat, just a little adhering to the wings. The brain case was untouched. A small garter snake was untouched, but Cope (1873) records a shrew's killing and partly eating a large garter snake. Red-backed salamanders, *Plethodon cinereus*, were greatly enjoyed, but a large spotted salamander, *Ambystoma maculatum*, was left untouched for ten days before it was finally killed and the lips and toes eaten. Mr. E. A. Preble has told me he once saw a Blarina killing a slimy salamander, *Plethedon glutinosus*. It had severed part of the tail. Frogs, as with the large salamander, were killed after an interval and the toes and lips alone eaten. Perhaps this area is less glandular and thus more tasty than the rest of the animal. Toads, both small and large, were untouched. Tadpoles of the green frog were completely eaten. Fish of all kinds were eaten avidly, and traps baited with sucker proved a very efficient lure.

No insects were refused; May beetles and their larvae, cutworms, of which they seemed to be very fond, hairy tent caterpillars and the larva of the woolly bear, *Isia isabella*, all were eaten. Ants were never eaten, and only a single specimen was ever determined in the stomach examinations. Small moths, bees and flies were never rejected.

Centipedes were eaten avidly, and the stomach analysis shows them to form an important part in the diet. They were taken much quicker than millipedes. Millipedes, strangely enough, were always left until last when a variety of food was offered at one time. Sowbugs are eaten quite often by shrews in the wild state. As many as 20 were consumed in a few hours' time by captives.

To my mind, slugs, *Agriolimax campestris*, were the most enjoyed by my captive specimens. When an assortment of food was placed before them, the shrews almost invariably made off with the smaller slugs. The larger slugs, *Limax maximus*, were not eaten. Snails were eaten at all times. *Planorbis*, *Limnea* and the terrestrial *Polygyra* were devoured. Usually the first two whorls were bitten through, and the contents pulled out.

Annelids were often fed the shrews. They seemed to prefer the smaller worms to the night crawlers, but the latter were eaten. Worms appear to play a smaller rôle in the diet than one would naturally suppose, considering that they are so common and easily secured.

Vegetable matter was fed almost daily, and a surprisingly large amount was taken. Sunflower seeds, raisins, apples, peanut butter, English walnuts, roots of the cat-tail (*Typha*), and soft corn were eaten, but hard corn was not touched. Mushrooms (*Coprinus*),

were eaten sparingly. In the winter, when some other foods are scarce, the short-tailed shrew resorts to plant matter, and a fourth of its food is of vegetable origin, as my examinations show.

RATE AND MANNER OF EATING

It took an adult shrew 6–10 seconds to finish a cutworm, which it first bit in the head to kill. The cutworm weighed one-third of a gram. The shrew began at the head end and worked caudally, using the forepaws for assistance in manipulating the insect.

Small slugs and sowbugs were taken into the mouth entire, but chewed well. Four minutes was the average time taken to consume a large nightcrawler. Feeding would almost always begin at the head end and proceed caudally. The rate and manner of eating mice has been so well described that nothing further will be said of it here. My observations point to a considerably slower eating than other writers describe.

AMOUNT OF FOOD EATEN

Much conjecture and little real observation has been given this subject. Morden, from his observations, conclude that the short-tailed shrew eats about twice or three times its weight every 24 hours. Brooks states that a captive shrew ate nearly three times its weight of grubs in a day. This shrew's daily average food taken was a little over 19 grams, a quantity equal to about one and a half times its own weight. Shull gives two-thirds of a meadow vole or one house mouse as the average daily supply. Other writers are in general agreement that this shrew will eat food equal to its own weight daily. Babcock found that two-thirds of a house mouse was sufficient for a day.

My observations with several shrews carried on for an entire spring convince me that one half the shrew's weight in food is ample for it over a 24 hour period, and more often than not, only one half of this much is daily eaten. I had a 22 gram shrew eat 20 grams of cutworms in as many hours, but this appeared to be exceptional, and the creature was sluggish after such a repast.

AMOUNT OF FOOD NECESSARY

Most observers attribute a ravenous appetite to this species, and add that if food is not available, the animal will starve in a short time. Seton (1909) says that numerous experiments and observations on captive animals prove that Blarina, like its smaller kin, has an enormous appetite which must be satisfied, or in a very few hours the creature

succumbs. Other writers appear to be pretty much in accord with this statement. Babcock found an uninjured shrew of this species dead in a cage trap 17 hours after setting, showing that death by starvation, (as he thought) took place in something less than that time.

I cannot hold with Babcock that his shrew necessarily died of starvation. I have had specimens of this shrew, that were taken in wire traps, dead 8 hours after setting, and again 20 hours after setting. The former had a well filled stomach, while food was still in the digestive tract of the latter, and some untouched bait remained in the trap. Babcock's shrew was likely chilled, or fretted itself to death, as these creatures often do in close confinement.

The studies of Rorig (1905) on the European shrew, *Sorex araneus*, in captivity show that a small amount of food is quite enough for this animal. This author kept a captive for 88 days, and in that time he fed it 3733 mealworms, 4 white grubs, 3 small frogs and a white mouse. All these combined totaled 601.5 grams for the 88 days, or an average daily of 6.8 grams of fresh food. The food was further analysed and Rorig found that the dried weight of the food eaten daily was 2.2 grams or only about one-fifth of the shrew's vital weight. If the shrew was kept alive and apparently in a healthy condition for nearly 3 months, it must have had all the food that was necessary for its well being. This experiment tends to show that the European shrew can subsist on a rather small amount of food, and is more in accord with my observations on captive short-tailed shrews.

To determine how long Blarina could dispense with food, and yet remain healthy, I fasted 3 of them over a 24 hour period on 4 different occasions, and they showed no apparent ill effects. On another occasion I kept food from a large male for *36 hours*, and except for a noticeable constriction in the abdominal region, this animal appeared none the worse for its long period of abstinence. Another died, however, probably of starvation, after going without food for 30 hours.

I believe that most captive shrews do not usually die of starvation, but from the effects of the shock that captivity involves. Shrews are very nervous and sensitive animals, and the slightest disturbance out of the ordinary is bound to effect them. Light often proves fatal to captives, and too dry an enclosure will tend to upset them. A damp home is almost imperative for the well being of these little animals.

STORAGE

That Blarina stores food for periods of adversity is unquestionable. The piles of snail shells frequently met with and the habits of captive

specimens in hoarding food give good evidence of this. Bachman (1849) speaking of *Blarina b. carolinensis*, writes:

"We observed in the sides of one of these galleries a small cavity, containing a hoard of coleopterous insects, principally composed of the rare species, *Scarabeus tityus*, fully the size of the animal itself; some of them were nearly consumed, and the rest mutilated, although some still living."

This is indeed a curious case of hoarding. Merriam (1886) is of the opinion that Blarina stores food, for when a captive was fed beechnuts, it stored most of the nuts. Shull found the half eaten remains of *Microtus* packed in the dirt about the tunnel of Blarina, but this might not have been an actual case of storage.

The habits of captive shrews would certainly indicate a propensity for storing food. When my short-tailed shrews were given more food than suited their appetite at one time, the excess food would be taken into the nest box and stored under the moss in a corner. More often than not, the greater part thus put away would turn bad before the animals were ready to eat it. Both animal and plant food was treated in this manner. Salamanders would be cut into several pieces, but raisins, sowbugs and other small things were stored intact. The storage habit was particularly pronounced in a nursing shrew, which refused to leave her young for long at a time.

FOOD OF SOREX CINEREUS

According to Jackson (1928), stomach examinations of *Sorex* have shown the following among the contents: Hymenoptera, Coleoptera, Diptera (both larvae and adults), caterpillars, crickets, spiders, hair and flesh of shrews and mice, and moss, seeds and other vegetable matter.

I have made 62 stomach examinations of this species, taken in 5 states and in Nova Scotia. Practically all were summer specimens, so little can be said of the food other than at this season. In all probability it is about the same as that of *Blarina* in winter. The percentage of the food, by bulk follows: Insects, 65.3 per cent; Vertebrates, 7.1 per cent; Centipedes, 6.8 per cent; Worms, 4.3 per cent; Molluscs, 1.4 per cent; Sowbugs, 1.2 per cent; Vegetable matter, 1.1 per cent; Inorganic matter, .9 per cent; Arachnida, .9 per cent; Undetermined, 10.9 per cent. The insects include 5 determined orders, Coleoptera, Diptera, Lepidoptera, Hymenoptera, and Orthoptera, but consisted chiefly of adult beetles and the larvae of all the other orders. Only 2 contained mammalian hair, and I strongly suspect that these had eaten trapped animals. Two

had salamander remains. Worms, as with *Blarina*, form a very small part of the diet. Vegetable matter was likewise rarely encountered in an analysis of these stomachs.

FOOD OF SOREX FUMEUS

Thirty-one stomachs of this shrew were examined, from several states. These were taken in February, April, May, June, July, November and December. In every stomach insect remains were found; they comprised 70.4 per cent of the bulk. They consisted of the following, in the order of their abundance: Undetermined larvae, Coleoptera, Diptera and Hymenoptera. One showed a trace of lepidopterous scales. Two stomachs contained centipede remains, while a like number had enough plant material to convince me that it was taken intentionally. One each had the remains of a sowbug, an earthworm and a salamander. The food, in percentage by bulk, is listed. Insects, 70.4 per cent, centipedes, 4.9 per cent, salamanders, 3.6 per cent, plant, 3.6 per cent, worms, 3.4 per cent, sowbugs, 2.8 per cent, inorganic matter, trace, and undetermined matter, 11 per cent.

FOOD	BLARINA BREVICAUDA 244	SOREX CINEREUS 62	SOREX FUMEUS 31	SOREX ALBIBARBIS 13
Insects	212	54	30	13
Annelids	44	2	4	1
Mollusca	26	2		1
Centipedes	19	8	8	
Millipedes	9	2		
Sowbugs	25	4	2	
Arachnids	11	4		
Vegetable	48	6	4	2
Vertebrates	21	6	2	
Inorganic	24	4	1	1
Empty	6			

CHART SHOWING NUMBER OF STOMACHS CONTAINING DIFFERENT FOOD ORGANISMS

FOOD OF SOREX PALUSTRIS ALBIBARBIS

Thirteen specimens of the water shrew were examined. 5 of these are from Maine, 4 from Nova Scotia, and 2 each from New Hampshire and Massachusetts. These were taken from May to September inclusive. All the shrews had eaten insects and 3 had eaten aquatic organisms, such as stone-fly nymphs, mayfly nymphs and planarians.

It is unlikely that the water shrew gets a large part of its diet from aquatic life. Its close proximity to streams and ponds would imply that some food is taken from the water; indeed its very structure points to this, but in all probability the larger part of its food comes from a terrestrial origin. The few stomachs examined would point to this, but the number is not sufficient to justify any conclusions. Remains of a Tabanid larva were found in one, but these larvae are found in damp leaves as well as the water. The percentage by bulk of the 13 stomachs is as follows: Insects, 78, which include Hemiptera (Jassids), Ephemeridae, Tricoptera, Coleoptera, Diptera and Hymenoptera; Inorganic substance, 1.5; planarians, 4.4; plant, 3.1; undetermined matter, 13.

SUMMARY

1. Stomach analysis of 244 *Blarina brevicauda* were made. Insects make up nearly one-half of the food, while next in abundance were vegetable matter, annelids, crustacea, molluscs, vertebrates, centipedes, inorganic matter, arachnids and millipedes in the order named. Only 4 stomachs contained mice. In the winter insects make up 60 per cent of the food eaten, and plant food is likewise taken extensively at this time.

2. Captive specimens ate mice, birds, salamanders, frogs and fish. Birds' eggs were not touched. No insects were refused. Centipedes, slugs, worms and millipedes were eaten, but the last named were apparently not much enjoyed. Vegetable matter was eagerly eaten.

3. The amount of food eaten is much less than commonly supposed. One-half the weight of the animal is a sufficient daily diet. The amount of food necessary for a short-tailed shrew is likewise small. A large male was fasted 36 hours without apparent ill effects. Shrews were fasted on several occasions for 24 hours, but one died, apparently from starvation, after fasting for 30 hours.

4. Storage is practiced by *Blarina brevicauda*.

5. Sixty-two stomachs of *Sorex cinereus cinereus* were studied. Insects comprised three-fifths of the food, while vertebrates, centipedes, worms, molluscs, sowbugs, vegetable matter and arachnids occur in abundance in the order named. Only 2 stomachs had mammalian remains. Worms form only a very small part of the diet.

6. Thirty-one stomachs of *Sorex fumeus* were examined. Every stomach contained insect remains, which comprised over 70 per cent of the food eaten. Centipedes, salamanders, plants, worms and sowbugs make up the rest. No mice were eaten.

7. *Sorex palustris albibarbis* is represented by 13 stomachs. All had eaten insects, and 3 contained aquatic organisms, such as the nymphs of stoneflies, mayflies and planarians. It is doubtful if the water shrew gets much of its food from the water.

LITERATURE CITED

BABCOCK, H. L. 1914. The Food Habits of the Short-tailed Shrew. Science, No. 1032, pp. 526–530.

BACHMAN, J. AND J. J. AUDUBON. 1849. Quadrupeds of North America. Vol. 2, p. 177.

BROOKS, FRED, E. 1908. Notes on the Habits of Mice, Moles and Shrews. W. Virginia Univ. Agr. Exp. Stat. Bull. 113.

CLENCH, W. J. 1925. Snails eaten by Shrews. Nautilus, Vol. 39, No. 1, July, 1925.

COPE, E. D. 1873. Account of captive Blarina killing and eating Water Snake. American Naturalist, pp. 490–491.

HAHN, WALTER L. 1909. Mammals of Indiana. 33d Annual Rep. Dept. Geol. and Natural Resources of Indiana.

JACKSON, H. T. T. 1928. A Taxonomic Review of the American Long-tailed Shrews. North American Fauna, No. 51.

MERRIAM, C. H. 1886. Mammals of the Adirondacks. N. Y. Henry Holt & Co.

MORDEN, J. 1883. Canadian Sportsman and Naturalist. Vol. 3, pp. 283.

RORIG, G. 1905. Über den Nahrungsverbrauch einer Spitzmaus. Arb. K. Gesunheitsamte. Biol. Abt. 4 (1903) No. 1, pp. 121, 122.

SETON, E. T. 1909. Life Histories of Northern Animals. Scribners. New York. Vol. 2, pp. 1125–1126.

SHULL, A. FRANKLIN. 1907. Habits of the Short-tailed Shrew. American Naturalist. 1907, pp. 495–522.

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BREEDING HABITS AND ECONOMIC RELATIONS OF THE DALLES POCKET GOPHER

By H. M. Wight

The material presented in this article is the result of cooperation between the Oregon State College Experiment Station represented by the writer, and the Dufur Orchard Company of Eastern Oregon, represented by Mr. H. C. Stockdale, efficiency expert with the Dufur Orchard Company, and Mr. J. R. Brown, assistant horticulturist, to whom was assigned the duty of controlling the pocket gopher in these orchards when it was unexpectedly found to be one of the foremost economic problems on this 7000 acre plant.

The gravity of the situation resulting from the work of this pocket gopher in orchards can best be illustrated by giving the result of a careful check made by Mr. Brown and myself during August, 1920.

The heaviest infestation was found in a 60 acre cherry orchard which ideally demonstrates the damage that may follow if any horticulturist in the area infested by the Dalles gopher, *Thomomys quadratus quadratus*, fails to practice efficient control measures. This orchard was not consistently summer cultivated, as is the usual custom in orchards of that section, and trapping had been discontinued as a hopeless task. It was found that 71 per cent of the trees had been killed and 21 per cent were injured beyond recovery, leaving less than 8 per cent of the trees uninjured. In badly infested apple orchards, situated along the margins of rough uncultivated pasture land or gullies, 60 per cent of the trees were either dead or badly injured in spite of the fact that these areas were cultivated. The more centrally located areas were not so severely attacked, but the presence of gopher work everywhere throughout this 4000 acre orchard made the problem exceedingly serious.

Up to the time the matter was brought to our attention by a letter from Mr. Stockdale, the Macabee trap had proved to be the only practical method of combating this little pest. Other work prevented the writer from giving direct attention to the problem at the time, but Mr. Stockdale was advised to determine this gopher's favorite food and to prepare a poison bait, using the formula given in Oregon Agricultural College Experiment Station Bulletin No. 153, which contains a method of control for the large gopher of the Willamette Valley, *Thomomys bulbivorus*. This was immediately done and the poisoned bait prepared by Mr. Stockdale and Mr. Brown gave such satisfactory results that the Macabee trap was discarded as a control method. It was

possible for the writer to spend three weeks during August at the Dufur Orchards where his time was used in checking the extent and nature of the injury, learning the horticultural methods in use, and studying the habits of this gopher for the purpose of improving the control methods.

The method finally devised gave an efficiency of approximately 88 per cent when the bait was used in a practical test made by Mr. Brown and the writer. Later Mr. Brown and Mr. Horn, of the Bureau of Biological Survey, got even better results for both this method and a slight variation of this method made by Mr. Horn. The control measures devised by the writer were used throughout the fall both on this orchard and on the Burtner ranch, adjoining the Dufur Orchards, where continued use over a period of two years practically eradicated this gopher from the Burtner orchards.

During the spring we were notified that the method was not giving satisfaction, its efficiency being apparently zero, and the writer was urged to come to the Dufur Orchard at once as the situation was again becoming serious. This was impossible so a letter was immediately sent asking Mr. Brown to conduct a trapping experiment to determine whether there were not several gophers inhabiting the runways at this time of the year, which would cause any poisoning method to appear less efficient than later in the year when only one gopher inhabited a runway.

Mr. Brown began the trapping at once and the results of this work provide the major part of the material for the discussion that follows. It will be advisable to mention briefly the general habits of *Thomomys quadratus*, and to indicate the nature of the injury caused by this pocket gopher.

It was found that the Dalles gopher made two types of runways when working in the orchards where a deep dust mulch is used to conserve moisture. A surface runway was apparently used very extensively during the summer months, running beneath the dust mulch, but through the hard ground. This surface runway was connected with a deep runway by a vertical shaft which descended directly to a depth of from four to five feet in the several instances examined. The nest was found at a distance of about ten feet from the bottom of this vertical shaft and consisted of a ten inch cavity filled with a mass of dried grasses, shredded leaves and root fibers. It is apparently in these deep nests that the young are reared and not in the smaller temporary nests frequently found in the surface runways which are probably used as resting and feeding stations.

Radiating from the region of the nest were found two types of blind tunnels, one used as storage pockets for food and the other used as latrines. Big heaps of dirt thrown up at the base of the trees provided evidence that the root systems of such trees has been severely attacked by the gopher and a very complicated system of runways was usually found beneath such trees. The mounds of most usual occurrence were much smaller and they apparently consisted of dirt that had been thrown out when the surface runways were constructed.

There is considerable evidence to indicate that these gophers migrated into the orchards in large numbers from the uncultivated surrounding pasture lands. Apparently the migration took place entirely beneath the ground, for repeated attempts by Mr. Brown, Mr. Stockdale and the writer to observe the gopher in the process of migration above ground both in the daytime and at night failed. Likewise constant search was made for their tracks in the fine dust mulch, which readily revealed the tracks of rabbits, squirrels, birds and even mice, but the tracks of the gopher were never found. In an attempt to determine the nature of this migration, Mr. Brown set traps in runways which passed beneath hard packed roads connecting pastures and orchards where he took as many as five mature gophers in one trap, which indicated this to be a general underground tunnel used in migration.

It was found that this pocket gopher fed largely upon alfilaria (*Erodium*) and nightshade (*Solanum nigrum*) when these plants were available, but it was determined that in apple and cherry orchards the bark and the cambium of the roots and trunks provided the bulk of the food, although apples were taken to some extent and were frequently found stored in caches near the nest.

The damage to the apple trees is largely through the root system, probably the most extensive injury being done by the severing of the smaller lateral and terminal roots, but nearly every gradation in the extent of damage has been observed. Trees were examined that had lost every root except the gnawed stubs of the main roots close to the tree. During the winter the gophers girdled the trunks of the trees at the surface of the ground, apparently working beneath the snow and removing in some instances all of the bark and cambium, leaving a girdled band from a few inches to over a foot in width. This type of injury of course soon kills the trees unless bridge grafting is done.

When the attack was confined to the root system alone, the tree frequently died slowly and evidence of "gopher sickness" was not conspicuous until the tree began to mature its fruit, when there occurred

a yellowing and premature falling of the leaves. Frequently when a prolonged dry period occurred, "gophered" trees which were apparently healthy suddenly became sickly in appearance and they usually died during the following year.

The following discussion of the breeding habits and the family interrelations that exist during the spring of the year are taken from the data provided by Mr. Brown's trapping experiment conducted in response to the writer's request.

The experiment began before Mr. Brown received complete directions from the writer and for this reason it has been necessary to eliminate the first 90 animals from the compilation of information which follows, because a careful examination of these was not made.

In outlining the work it was necessary to take into consideration the fact that Mr. Brown was employed by a strictly commercial concern and therefore that there were limitations to the nature of the information that could be expected. Thus such details as measurements, weights, and preparation of material for cytological and embryological examination were omitted.

Two Macabee traps were set and were kept reset in individual gopher systems of runways. The animals taken were carefully examined for sex, condition of uterus, and the relative age of each animal was carefully recorded.

The trapping experiment extended from March 9 to April 11, 1921. During this period 552 gophers were taken, but as previously mentioned, the first 90 have been omitted from this discussion because they were not opened to record sex, condition of uterus, and other details, therefore the data actually considered here were gathered between March 14 and April 11, and consist of the results of an examination of 133 mature males, 112 mature females, 112 young males, and 105 young females, making a total of 462 animals investigated.

Before continuing with the conclusions that have been drawn from this information, I wish to mention that Mr. J. R. Brown, who conducted this work, was a graduate from a university in Scotland and was a trained technician. His field notes were the equal of any the writer has examined.

Intimate knowledge of the breeding habits of the pocket gophers has been exceedingly difficult to acquire. Scheffer in 1907–08, working with the prairie gopher in Kansas, seems to be the first to gather definite information. He found that this gopher has but one litter per year, and that the number runs from three to six and averages a little more than

four. He considers this gopher solitary in its habits throughout most of the year.

While working with the Willamette Valley gopher, *Thomomys bulbivorus*, the writer found that the breeding period extended from March to

POCKET GOPHERS TRAPPED MARCH 9 TO APRIL 11

				NUMBER	PER CENT
Gophers trapped—total	552		Normal females with males	8	32
Number eliminated here	90		Males alone	36	27
Total considered	463		Males with young	38	28
	NUMBER	PER CENT	Males with males	12	9
			Males alone with young	26	19
			Males with females and young	14	10
			Males with pregnant females and young	8	6
Mature males	133	29	Males with suckling females and young	3	2
Young males	112	24	Young alone	95	42
Mature females	112	24	Young in litters of two	36	
Young females	105	23	Young in litters of three	36	
Females normal	25	22	Young in litters of four	16	
Females pregnant	59	52	Young in litters of five	0	
Females suckling	28	26	Young in litters of six	1	
Females alone	33	29	Size of litters by foetal examination.		
Females with young	36	32	Nine foeti	2	
Females with males	52	46	Eight foeti	0	
Females with females	2	1	Seven foeti	9	
Females with young alone	22	19	Six foeti	9	
Females with males alone	37	33	Five foeti	3	
Pregnant females alone	14	24	Four foeti	2	
Pregnant females with young	21	35	Three foeti	0	
Pregnant females with males	31	58	Average number in litter	6.5	
Suckling females alone	9	32			
Suckling females with young	10	35			
Suckling females with males	13	46			
Normal females alone	10	40			

July, that there was apparently but one litter per year, and that there was evidence that the animals were solitary in their habits except during the mating period. A litter of young was successfully raised to maturity and the behavior of the mother at weaning time was noted. At this time the young became absolutely solitary in their habits. This laboratory information was verified by field observations. Males and

females were never taken from the same runways, although approximately 100 gophers were trapped. The largest litter taken from or with a female was nine and the smallest five, with five as the usual number taken.

Horn, working simultaneously with Brown, but with *Thomomys townsendi*, at Vale, Oregon, obtained conclusive evidence that two litters are produced in rapid succession. He also found males and females inhabiting the same runway.

It would seem that inferences that may be drawn from the 462 animals taken in the brief period of approximately one month, March 14 to April 11, would provide the most extensive information obtained for the breeding habits of any species of pocket gopher thus far studied. That March 14 to April 11 marked the peak of the breeding period for this gopher is indicated by the large number of females that showed signs of breeding, there being 79 per cent of the mature females either pregnant or suckling young, and further, by the fact that 217, or 47 per cent, of the entire catch were young animals, apparently recently born.

It will be remembered that the original purpose of this experiment was to determine whether more than one gopher inhabits a system of runways during the spring. This was definitely demonstrated to be the case, for in the 288 different gopher systems trapped, 144, or 50 per cent, were found to be occupied by two or more animals, and as many as eight animals were taken from one system. It was observed in the case of *Thomomys bulbivorus* that the young were sufficiently developed at the age of three weeks to take succulent foods, thus the small amount of bait intended as a lethal dose for but one gopher could readily have been carried to the nest and mixed with other foods there and eaten in such small quantities by the several gophers that it proved fatal to none. Thus it would appear that spring poisoning methods would require that special consideration be given to the amount of bait used, the number of baits placed in each runway and possibly an alteration in the type of bait and in the amount of poison used. It is evident that an efficiency test based upon the assumption that but one gopher inhabits the runway is without value for *Thomomys quadratus* during late winter and early spring at least.

Aside from this practical aspect, considerable information may be derived from an interpretation of the several combinations of different types of gophers that were found in the same system of runways, that suggests answers to many different questions in the natural history of this animal, and especially does it throw light on the family relationships during this period.

Although on one or two occasions it has been intimated that pocket gophers may have two litters in a season, the only definite information published to date seems to be that given for *Thomomys townsendi* by Horn.

Mr. Brown trapped pregnant females with young on 21 different occasions; 36 per cent of all of the pregnant females trapped were taken with young. Thus it is evident that *Thomomys quadratus* has two litters in rapid succession.

It was found during the study of *Thomomys bulbivorus* that the mother demonstrated an attentive maternal instinct and that the young lived a perfectly tranquil life up to an age of approximately six weeks, when the mother suddenly turned exceedingly vicious toward her offspring and literally kicked them out into the wide wide world, plugging the doors to her home against them, and from that moment on the little ones not only fought one another viciously, but appeared belligerent to everything that came in their way. In this connection it is interesting to note that 95, or 44 per cent, of all the immature gophers taken in this experiment were leading solitary lives, which might indicate that mother 'quadratus,' like mother 'bulbivorus,' may also drive her young from home at an early age.

It being practically certain that the female bears two litters in rapid succession, we would like to determine when the second period of pregnancy starts, and what the general relationship of the male is to the family life during the development of these two litters.

Of the 112 mature females trapped, 52, or nearly 46 per cent, were taken with males; 31 of the 59 pregnant females, or 52 per cent, were taken with males, while 47 per cent of the suckling females and 32 per cent of the normal females were taken with males. It would seem that the males must be welcome in runways of the females throughout the entire period we trapped, and that the male seeks the female in her runway, for the second mating at least, is indicated, because it is demonstrated that the second period of pregnancy begins while the female is caring for her first litter and therefore cannot leave them. This is further substantiated by the presence of the male with the pregnant female and her young.

It was determined in the work with *Thomomys bulbivorus* that it requires from six to seven weeks for the young to reach the stage when they are weaned, and it is logical to assume that *Thomomys quadratus* does not vary greatly from *Thomomys bulbivorus* in this respect. Since the period of gestation probably does not exceed the period of development to weaning time, we may assume that gestation requires from 40

to 50 days if the second mating rapidly follows parturition as is quite usual with polyoestrous rodents. The fact that pregnant females which were suckling young were taken more frequently with males alone than with males and young would indicate that the second mating took place at an early date following the first parturition.

While the males were apparently welcome at all times during this period in the home of the females, such appears not to be the case with other females, for in only two instances were females taken from the same runway and in one of these cases there was evidence that these two animals may never have met as the second female was taken several days after the first one. The infrequency of their association together is very good evidence for believing that females do not tolerate one another. Antagonism among the females was very evident in the study of *Thomomys bulbivorus*.

Similar evidence exists for the males, for two males were taken from the same burrow only 12 times and with the exception of but one instance several days elapsed between the trapping of the first and second gopher. It would seem likely that male gophers would have been found together more frequently if their relationship was amicable.

A record of the number of embryos per individual was kept for 25 of the pregnant females. The distribution by numbers was as follows: 2 with 9, 9 with 7, 9 with 6, 3 with 5, and 2 with 4 embryos each, with an average of between 5 and 6. Seventy-nine different litters were trapped. They did not average, however, as many per litter as was demonstrated by an examination of the pregnant females. There was only one instance of six young taken from a litter, 16 of 4, 26 of 3, and 36 of 2. This would indicate one of two things: either a heavy mortality among the young, or a partial migration of young before trapping was initiated. It is probable that the latter is the more logical explanation, although weasels could readily have taken many young as these were trapped in several instances apparently coming from the gopher runways.

SUMMARY

1. An efficiency test for a method of poisoning based upon the assumption that but one animal inhabits a runway is valueless for *Thomomys quadratus* during the late winter and early spring at least.

2. A method of poisoning during the spring necessarily requires a larger amount of bait—and improved results would probably be obtained by several applications made at different places in the system of runways.

3. A male, a female, and several young may inhabit the runway at the same time, demonstrating an unexpected family relationship.

4. At least two litters of young gophers are produced in rapid succession.

5. Apparently the young are weaned at an early age and soon begin a solitary life.

6. The fact that pregnant females were taken more frequently with males alone than with males and young indicates that mating takes place at an early date following the first parturition.

7. The males are apparently permitted to remain in the runways of the females throughout both periods of pregnancy and at least throughout the period of development of the first litter.

8. Two males probably do not inhabit the same runway.

9. Information indicates that the male seeks the female in her runway.

10. The fact that two males were infrequently taken in the same system of runways and with the possibility that they did not live together there indicates that the males are not at all gregarious and possibly meet only as antagonists.

11. There was no definite evidence obtained on the period of gestation, but the possibility that it is from 40 to 50 days was pointed out.

12. The largest number of foetuses taken from a pregnant female was nine, and the smallest number was four, with an average of 6.5—six and seven being the numbers usually found.

13. The number of litters trapped from individual systems of runways was 79. The size of these litters was much smaller than the information gathered by foetal examination indicated. The suggested explanations included heavy mortality or partial migration before trapping.

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LITERATURE CITED

HORN, EVERETT E. 1921. Some notes concerning the breeding habits of Thomomys townsendi observed near Vale, Malheur Co., Oregon, during spring of 1921. Journ. of Mamm., Vol. 4, No. 1, p. 37.

SCHEFFER, THEO. H. 1910. The pocket gopher. Kansas State Agricultural College Experiment Station Bulletin 172.

WIGHT, H. M. 1918. The habits and control of the pocket gopher of the Willamette Valley, Thomomys bulbivorus. Oregon Experiment Station Bulletin 153.

1920. Preliminary report on the method of poisoning the Dalles gopher, Thomomys quadratus, of eastern Oregon, Dec. 1920 (circulated but not published).

1920. Pocket gophers of Oregon. Oregon Countryman, Vol. 12, No. 7, p. 18.

1922. The Willamette Valley Pocket Gopher. Murrelet, Vol. 3, p. 6–8.

NOTES ON CERTAIN FORMS OF THE HOUSE MOUSE (MUS MUSCULUS), PARTICULARLY THOSE OF EASTERN NORTH AMERICA

By Francis Harper

Any one who attempts to deal with the excessively complicated problem of the status and distribution of the various forms of *Mus musculus*, in its cosmopolitan range, may easily be charged with temerity. The present paper, however, takes up only a small part of the whole problem. On this subject Barrett-Hamilton and Hinton (1916, p. 648) have appropriately remarked: "A systematic study of the American colonies of *Mus* . . . might yield important information concerning the mechanics of geographical variation."

According to Miller (1912, pp. 865–874), the North European house mouse (*Mus musculus musculus*) inhabits Europe north of the Mediterranean region (Iceland, British Isles, and Scandinavia south to Switzerland and Hungary), while the South European house mouse (*M. m. azoricus*) occupies the Mediterranean region (France, Portugal, Spain, Italy, and Greece) as well as the Azores. In view of the amount of ocean traffic between southern Europe and America, it would seem strange indeed if the latter subspecies did not become transplanted to the New World. Yet there seems to be not the slightest reference in the literature to such an occurrence.

J. A. Allen (1894, p. 175; 1896, p. 59; 1897a, p. 35; 1897b, p. 116; 1904, pp. 435–436; 1910, p. 101) has discussed certain color variations of the house mouse in Texas, Nicaragua, Costa Rica, Colombia, and Peru, without giving them nomenclatural recognition. A well-marked form in Jalapa, Vera Cruz, Mexico, was, however, named by Allen and Chapman (1897, p. 198) as *M. m. jalapae*. Dice (1912) has pointed out color variations in California. It is not my present purpose, however, to deal with specimens from the regions just mentioned.

The perplexing status of the house mouse is reflected in the fact that various recent authors give it no more than a binomial designation in referring to its occurrence in certain localities where it has been introduced, such as Australia (Le Souef and Burrell, 1926, p. 143), California (Hall, 1927, p. 189), and the Pribilof Islands, Alaska (Preble, 1923, p. 113). The only subspecific designation employed hitherto by numerous authors in referring to the house mouse in North America north of Mexico seems to have been *Mus musculus musculus*.

My curiosity on the subject became aroused on October 1, 1928,

when George H. Mackay brought from Nantucket to the Boston Society of Natural History two freshly caught adult house mice, and called attention to a difference in the appearance of the two specimens. One was evidently *Mus musculus musculus*, with under parts nearly as dusky as the upper. But the other was much paler and more buffy beneath, with a conspicuously light-colored throat. Miller (1912, pp. 870–873) shows no pronounced or constant differences in skin or skull measurements between *M. m. musculus* and *M. m. azoricus*, and apparently coloration must be relied upon as practically the sole criterion in differentiating these two subspecies. On this basis it seems necessary to refer the second Nantucket specimen to *azoricus*.

After looking over additional material in the collection of the Boston Society of Natural History as well as in the Museum of Comparative Zoölogy, the United States National Museum, and the Cornell University Museum, I conclude that specimens from various localities in eastern North America and from islands in adjacent seas may be allocated to the two forms as follows:

Mus musculus musculus LINNAEUS

NEWFOUNDLAND: Bay St. George, 1. NOVA SCOTIA: Digby, 1. MAINE: Mount Katahdin, 1; Upton, 2. NEW HAMPSHIRE: Webster, 1. MASSACHUSETTS: Boston, 7; Cambridge, 4 (1 intermediate); East Lexington, 1; Feltonville, 1; Hamilton, 1; Holbrook, 2 (intermediate); Hudson, 6; Nantucket, 1; Newton, 1; Wareham, 11. NEW YORK: Axton, 1; Ithaca, 1; Potsdam, 2. DISTRICT OF COLUMBIA: Washington, 1. WEST VIRGINIA: White Sulphur Springs, 1 (intermediate). MISSOURI: Stotesbury, 7. LOUISIANA: Burbridge, 8 (intermediate).

Mus musculus azcricus SCHINZ

QUEBEC: Ellis Bay, Anticosti Island, 3. MAINE: Emery Mills, 2. NEW HAMPSHIRE: Webster, 2. MASSACHUSETTS: Barnstable Neck, 1; Nantucket, 1. RHODE ISLAND: Block Island, 1. GEORGIA: Cuthbert, 1; Montgomery, 5; Okefinokee Swamp, 3; Sterling, 4. FLORIDA: Key West, 6. MISSOURI: Stotesbury, 1. LOUISIANA: Burbridge, 57; near Gibson, 6. BERMUDA: 3. BAHAMAS: Nassau, 2. LESSER ANTILLES: Guadeloupe, 5; St. George, Grenada, 1.

In determining the specimens listed above, I have had for comparison the following European specimens of *Mus musculus azoricus*, loaned by the United States National Museum. France: Is-sur-Tille (Cote d'Or), 7 (3 intermediate); Gievres (Loir-et-Cher), 2. Spain: Bejar (Salamanca), 1. Italy: Florence, 2.

The following European specimens of *Mus musculus musculus*, from the collections of the Museum of Comparative Zoölogy and the United States National Museum, were also examined. Norway: Finmark, 2. England: Clevedon (Somerset), 2. Ireland: Ballyferriter (County Kerry), 1. France: Is-sur-Tille (Cote d'Or), 1.

Not all of the specimens listed are entirely typical of either form, some being referred rather arbitrarily to the one or the other. One finds very complete intergradation as well as rather pronounced individual variation. Since transportation of house mice by ship, train, and various highway vehicles must take place on a considerable scale, it doubtless happens frequently that a representative of one form finds itself in a locality inhabited chiefly by the other form. In such cases interbreeding seems likely to occur and to result in intermediate offspring. These would really be crossbreeds between the two subspecies, and therefore of a somewhat different status from intergrades along the geographic boundary between the ranges of two normal subspecies.

It is interesting and probably significant that the great majority of specimens from the more northerly localities in America are *musculus*, and from the more southerly localities, *azoricus*. This largely complementary distribution furnishes a parallel to the distribution of the two forms in Europe.

It may be assumed, or at least conjectured, that specimens of *azoricus* in Quebec and New England represent recent introductions from southern Europe or from the southern United States; likewise, that specimens of *musculus* in the Southern States represent recent introductions from northern Europe or the Northern States. In either case the stock represented by the newcomers seems likely to become gradually submerged in the dominant population of the other form, either by interbreeding or by direct action of the climatic environment upon successive generations.

Some of the most extreme specimens of *azoricus* (from Emery Mills, Maine; Nantucket, Mass.; Cuthbert, Sterling, and Okefinokee Swamp, Ga.; and Florence, Italy) have under parts varying from vinaceous-buff to ivory yellow and cartridge buff, with throats still paler. The question arises whether these might not be representatives of the light-colored "outdoor" house mice discussed by Barrett-Hamilton and Hinton (1916, p. 639). Of the eight specimens, three (two from Emery Mills, Maine, and one from Cuthbert, Ga.) were actually taken outdoors at a considerable distance from any habitation, but two others (from Nantucket, Mass., and Okefinokee Swamp, Ga.) were found indoors. Furthermore, another specimen from the last-mentioned locality, though captured in a field, has darker under parts than the indoor specimen. The meager evidence thus accumulated in regard to the possible occurrence of a light-colored "outdoor" race of house mice in America is inconclusive or contradictory.

Since eastern North America and western Europe have moderately similar climates, it is hardly to be expected that stocks of *Mus musculus* derived from Europe would develop in this part of America into forms appreciably different from the ancestral ones. However, the marked color variations that have been noted in some of the Western States and in Central and South America have very likely been brought about by more or less decided differences in climate and vegetation between those regions and Europe.

LITERATURE CITED

ALLEN, J. A. 1894. On the mammals of Aransas County, Texas, with descriptions of new forms of Lepus and Oryzomys. Bull. Amer. Mus. Nat. Hist., vol. 6, art. 6, pp. 165–198, 1 map.

———1896. On mammals collected in Bexar County and vicinity, Texas, by

Mr. H. P. Attwater, with field notes by the collector. Bull. Amer. Mus. Nat. Hist., vol. 8, art. 5, pp. 47–80.

———1897a. Additional notes on Costa Rican mammals, with descriptions of new species. Bull. Amer. Mus. Nat. Hist., vol. 9, art. 3, pp. 31–44, 1 pl.

——— 1897b. On a small collection of mammals from Peru, with descriptions of new species. Bull. Amer. Mus. Nat. Hist., vol. 9, art. 8, pp. 115–119.

——— 1904. Report on mammals from the district of Santa Marta, Colombia, collected by Mr. Herbert H. Smith, with field notes by Mr. Smith. Bull. Amer. Mus. Nat. Hist., vol. 20, art. 35, pp. 407–468, 4 figs.

——— 1910. Additional mammals from Nicaragua. Bull. Amer. Mus. Nat. Hist., vol. 28, art. 9, pp. 87–115.

Allen, J. A., and F. M. Chapman. 1897. On a collection of mammals from Jalapa and Las Vigas, State of Vera Cruz, Mexico. Bull. Amer. Mus. Nat. Hist., vol. 9, art. 13, pp. 197–208.

Barrett-Hamilton, G. E. H., and M. A. C. Hinton. 1916. A history of British mammals, part 19. London: pp. 601–648, 2 pls., 4 figs.

Dice, L. R. 1912. Color variations of the house mouse in California. Science, n. s., vol. 35, May 24, pp. 834–836.

Hall, E. R. 1927. An outbreak of house mice in Kern County, California. Univ. California Publ. Zoöl., vol. 30, no. 7, pp. 189–203.

Le Souef, A. S., and Harry Burrell. 1926. The wild animals of Australasia. London: pp. 1–388, 113 figs.

Miller, G. S., Jr. 1912. Catalogue of the mammals of Western Europe. London: pp. xv + 1019, 213 figs.

Preble, E. A. 1923. Mammals of the Pribilof Islands. North Amer. Fauna No. 46, pp. 102–120, 1 pl.

NOTES ON THE GOLDEN HARVEST MOUSE

By Ruth Dowell Svihla

[*Plate 3*]

The golden harvest mouse, *Reithrodontomys fulvescens aurantius*, occurs frequently in southern Louisiana. In the marsh region south of Morgan City, it prefers the slightly higher locations along the bayou banks, near the edges of tree islands and drained areas where the tidal waters do not normally reach. Its local habitat is shared with the rice rat, *Oryzomys palustris texensis*, and the cotton rat, *Sigmodon hispidus hispidus*. Under the thick tangle of marsh vegetation, the common runways of all three of these rodents form veritable networks in some places. In traps set in these runways, either one or all of these species may be caught.

Nests of the harvest mouse are found generally several feet from the ground concealed in tangled masses of the rank marsh vegetation. Upon Avoca Island, which is drained more or less for agricultural purposes, these mice, as well as rice rats and cotton rats, seek protection and shelter under the rosette leaves of huge thistles. The harvest mouse nests, however, are almost always at least several inches from the ground. The nests are made of finely shredded leaves of various marsh grasses and sedges such as the roseau, *Phragmites communis*, paille fine, *Spartina patens juncea* and *Panicum hemitomum*. Seldom larger than a baseball, the nests are quite compact. In the majority of cases they shelter a pair of mice. These nests are easily distinguished from those of the rice rats and cotton rats on account of their smaller size.

Harvest mice are, perhaps, the most dainty of all rodents. They accustom themselves readily to captivity, and if given a wheel soon learn to perform various antics. One mouse learned to jump on and off while the wheel was going at full speed and often reversed directions when at top speed. Another favorite trick was to start the wheel going and then cling tightly while the momentum provided a ride. The mate to this mouse often climbed into the wheel and clung tightly while the male ran it. In a short time, the male would become tired and after nosing her suggestively with no result, would jump off. Harvest mice are very clean and spend much time washing and licking themselves. Taking their long tails in both forepaws, they wash the entire length, licking thoroughly. The males, especially when sexually excited, emit a tiny, clear, high-pitched bugling sound, very ventriloquistic in charac-

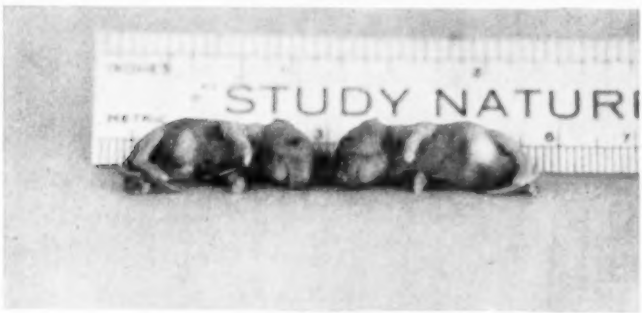
ter. No other sound has been heard from them. Two females, when placed in the same cage with but one male, fought quite savagely and one of the females had her tail very badly bitten. Two males placed together, got along very well until a female was introduced into the cage.

In March, a pregnant female was captured and after being in captivity a week, gave birth to two young. The young were pink in color, blind and hairless. They weighed 1.07 and 1.15 grams respectively. Unfortunately, the female escaped from the cage and abandoned her young the day after they were born.

In nature, these mice feed not only on seeds but also on the tender and succulent shoots of marsh grasses and sedges. In captivity, they eat various things among which are germinated oats, apple, pear, carrot, rolled oats, chicken chow, and cheese. For two weeks, the food consisting of the above variety that was given to a pair of harvest mice, was weighed daily in order to determine approximately the amount consumed. It was found that each mouse ate on the average 8.49 grams of food daily. The average weight of a mouse was 26.37 grams so that each one consumed an average of 32 per cent of its weight per day. This is considerable when the small size of these mice is taken into account.

One pellet of the barred owl, *Strix varia alleni*, was found to contain the remains of four harvest mice. Snakes, such as the water moccasin and blue runner which are so common in the marshes and which have been found to prey upon rice rats and cotton rats, no doubt have little compunction about including harvest mice in their diet.

University Museums, University of Michigan.



UPPER: ADULT REITHRODONTOMYS FULVESCENS AURANTIUS; MORGAN CITY, LA., FEBRUARY 15, 1927

MIDDLE: NEWBORN YOUNG OF REITHRODONTOMYS FULVESCENS AURANTIUS; MORGAN CITY, LA., MARCH 16, 1927

LOWER: VENTRAL ASPECT OF SKULL OF DENDROHYRAX CRAWSHAYI CRAWSHAYI; MOUNT KENIA, BRITISH EAST AFRICA

ON MAMMALIAN AUDITORY BULLAE SHOWING AN INDISTINCTLY COMPLEX STRUCTURE IN THE ADULT

By C. J. van der Klaauw

[*Plate 3*]

Comparative anatomical study of the auditory bulla in dry adult skulls of mammals, as thoroughly done by Van Kampen (1904, 1905; for later additional literature see Van der Klaauw, 1925) for all the different groups of mammals, has brought out not only the enormous variety of structure in this region of the skull but also the fact that in many cases these features are very characteristic and of much importance both systematically and in the determination of the relationships of different groups. Among these characters the number and kind of skeletal elements which constitute the bulla is of special interest. Investigations on dry skulls have doubtless shown in many cases that the bulla consists of more than one element. In many other cases however the dry skull, often even of very young individuals, shows but one skeletal element; at all events vestiges of a compound structure are, if not entirely absent, very rare, indistinct or dubious. Now in a few recent investigations of the head (in which the soft parts and the cartilage are preserved) of late-foetal and newborn, it has been shown that the bulla is distinctly compound (Van der Klaauw, 1922, a & b, 1924, 1929). No doubt in these cases the various elements of the bulla fuse early in ontogeny, leaving in the young or adult skull no or practically no trace of their original independence. This is easily understood in those cases where primordial fusion occurs and also where one of the elements does not show a separate center of ossification, but where its ossification starts from another element. The apparent simplicity of the auditory bulla when only one element is discernible on the dry skull occasionally results from the loss of the second element during maceration. This occurs when the element is either cartilaginous throughout life or partly ossified or entirely bony, and in the latter cases entirely free or but very loosely attached.

These data from the study of the head of late-foetal and newborn mammals warn us to be careful in using the auditory region in dry skulls for settling questions of relationship. On the other hand the necessity of a renewed investigation of dry skulls is clearly indicated. This article contains the results of a reinvestigation of such skull-material, done by me in the Zoological Museums at Berlin (1922), Washington (1923), Lon-

don (1927) and Leiden (1928). For kind permission to study this material my thanks are due to the late Dr. Paul Matschie; Mr. Gerrit S. Miller, Jr., Dr. M. A. C. Hinton, Dr. F. A. Bather, and Mr. A. T. Hopwood; and Prof. Dr. E. D. van Oort. The investigations were made on the spot, those in the foreign museums during my trips undertaken with the financial support of the fund of Mr. H. Vollenhoven, the "Nederlandsch-Amerikaansche Fundatie" and the "Bachiene-Stichting."

PROCAVIA (HYRAX)

Parker (1874, p. 320, footnote) found in a new-born hyrax "a large bulla, ossified separately from the true tympanic "annulus" and evidently formed in a shell of true cartilage." Van Kampen (1904, p. 287; 1905, p. 623) notes that this entotympanic must fuse very early with the tympanic. In a very young, probably new-born, *Procavia capensis*, this author found no trace of a suture in the already entirely ossified bulla. Van Kampen's note (1904), p. 43; 1905, p. 364) that the entotympanic occupies but a small portion of the bulla, is not true according to my investigations (Van der Klaauw 1922 a & b). Not only in embryos of *Procavia capensis*, but also in those of *Procavia abyssinica* and *P. syriaca* I could demonstrate the presence of a strongly developed cartilaginous rostral entotympanic next to a rudimentary caudal entotympanic. In my oldest specimen the rostral entotympanic locally adjoins the tympanic very closely, no distinct separating layer of connective tissue being visible, which makes it very probable that the rostral entotympanic unites with the tympanic early without trace of a suture (Van der Klaauw 1922a, p. 32; 1922b, p. 166). Perhaps even the rostral entotympanic ossifies from without the tympanic.

This investigation of the compound structure of the bulla is based on a large number of dry skulls of recent Hyracoidea: about 650 at Berlin, a considerable number at Washington, 419 at London, and 16 at Leiden.

In none of the skulls examined is there a distinct suture in the bulla; at all events, in none of the cases in which a distinct line is present would I dare to conclude with absolute certainty that this line represents a suture.

A distinct boundary however between the two components of the bulla can occur, but only in very young skulls. On the other hand not all young skulls show this feature, perhaps because of specific characters or individual variations. Even in the first mentioned group of specimens sometimes one bulla shows this boundary well and the other one not at all or less distinctly. Considering moreover the fact that skulls of new-born and very young individuals are relatively seldom found in museum collections, this explains the very low percentage of skulls in which the suture in the bulla can be recognized. At Berlin I noticed 32 specimens with a more or less distinct kind of boundary; in Washington there are 4 young specimens with a distinct boundary, an extremely beautiful one is Cat. no. 163933, *Dendrohyrax crawshayi crawshayi;* ♀, Mt. Kenia, B. E. Africa, Oct. 14, 1909, J. A. Loring (see lower fig., pl. 3). In the London collection a small number of skulls showed a boundary but in five skulls only was it very distinct.

In these young skulls this distinct boundary has the appearance of a narrow line which could very well be a line of fusion of the two principal components of

the bulla, the tympanic and the rostral entotympanic. Reasons for this belief are, that if there are remnants of a line of fusion they are to be expected in the youngest skulls, that the topographical position of this line agrees with the facts known from the embryological study, and thirdly that this line of fusion coincides in position with the interesecting line of the external surfaces of the two principal components of the bulla which in such young skulls do not necessarily pass gradually into one another. In this respect we can distinguish two types, which perhaps depend on specific differences. The external surfaces of the two parts of the bulla may meet each other at an angle of about 160°; on the intersecting line we find externally a narrow bony line-like edge, which in my opinion forms the line of fusion. In the other type each of the two parts of the bulla shows its own convexity, in such a way that in the region where they come together the external surface of the bulla shows a more or less shallow groove bearing the line of fusion. There is every reason to believe that this groove separates the two principal components of the bulla and that therefore the line represents the line of fusion of tympanic and rostral entotympanic. In the very young cat we have a similar condition; in the adult *Procavia* this groove entirely disappears. In the adult cat it nearly disappears and does not remain as a deep groove such as occurs, for instance, in *Mylodon* and *Hapalops* or as a distinct external constriction such as we find in Viverridae. This groove in the very young skull of *Procavia*, just as in the cat, has nothing to do with a future furrow on the external surface of the bulla, such as occurs in the Cetacea, nor with a *vagina processus hyoidei*. This all makes it seem very probable that the groove in the young skull of *Procavia* marks the line of contact between tympanic and rostral entotympanic.

In the older skulls of *Procavia* boundaries of this kind are entirely absent. The transition is a gradual one and sometimes there seems to be a remnant of the line of fusion in specimens of a little more advanced age. In none of the older skulls, however, is there a distinct limit between the two portions, as described above. In the region where we might expect the line of fusion we sometimes find a more or less distinct narrow edge, or a dark colored line, or narrow band, or ribbon, or a narrow row of minute pores or pits. None of these features, however, is distinct enough to indicate that it must be a remnant of the line of fusion. Moreover we know from the conditions present in *Canis* that we must be very prudent in interpreting lines on the external surface of the adult bulla, as such lines do not necessarily coincide with the boundaries of the component skeletal elements. No internal character of the bulla in *Procavia* can be utilized to locate the boundary between the tympanic and rostral entotympanic on the external surface. There is no *septum bullae* as in the Felidae. The position of the line of fusion in relation to the medial margin of the internal slit-like excavation on the inner side of the *margo sulci* is not known; that they coincide as Van Kampen (1904, 1905, fig. 81) figures is possible and even perhaps probable, but it is not positively known (Van Kampen did not know the extension of the entotympanic). The necessary investigation on the development of the *sinus hypotympanicus* in material which still shows the boundary between the tympanic and rostral entotympanic, is not yet done. For this reason also the indistinct differences shown by the two portions of the bulla in a number of old skulls are of little value in this respect. At the utmost we can say that the portion probably formed by the rostral entotympanic differs in those skulls from the portion probably formed by

the tympanic. These differences, which in the Berlin material could be found in about one-fourth of the specimens, consist of differences in color, in transparency and in roughness of the external surface, the medial (entotympanic) portion being more transparent and more rough. Similar differences in transparency between the tympanic and the entotympanic portion of the bulla are known in *Plecotus auritus* and differences in roughness in *Hapalops*.

GALEOPTERUS

In considering a published observation which seemingly referred to a suture in the dorsomedial margin of the auditory bulla, Van Kampen (1904, p. 138; 1905, p. 463) pointed out that, if this statement was not entirely incorrect, we had to conclude that perhaps an entotympanic occurs which soon fuses with the tympanic. In embryos of *Galeopterus*, I (1922 a & b) could demonstrate a small cartilaginous rostral and caudal entotympanic, occupying the dorsomedial margin of the bulla. The embryos were too young to study the mode of ossification of these entotympanics and their way of uniting with the tympanic.

To find traces of this compound structure I examined 34 skulls at Berlin, 76 at London, and 19 at Leiden.

Dry skulls of very young individuals show the well-known broad cleft between the dorsomedial margin of the tympanic and the petrosal. In all these young skulls the cleft is entirely free from skeletal elements. Only two specimens among the Berlin material showed a small piece of bone lying in this cleft. In one specimen it was attached to the tympanic and free from the petrosal, forming a distinct angle with the tympanic. In the other specimen it seemed to be free from the tympanic as well. Very probably this element is an ossified entotympanic.

In older and adult skulls this cleft is closed by bone, probably by the ossified entotympanic, which constitutes the dorsal portion of the medial margin of the auditory bulla. Tympanic and entotympanic are firmly fused. None of these skulls showed a distinct suture; in a very few of the older ones I could find an indistinct groove or line on the external surface of the bulla which might be a line of fusion of tympanic and entotympanic. In a few skulls the external surface of this dorsal margin is very little rougher than that of the rest of the bulla (the tympanic portion).

ICTICYON

Huxley (1880, p. 270) wrote of the skull of *Icticyon venaticus* Lund: "The tympanic bullae are not evenly arched as is usual in the smaller Thooids; but the outer is separated from the inner moiety of the convex surface by a well-defined oblique ridge." Van Kampen (1904, p. 191; 1905, p. 520) mentions this as the most distinct external division of the bulla into two portions among recent Canidae, in which generally such an external division is unusual or indistinct.

A specimen (Cat. no. 18911) of *Icticyon venaticus* Lund in the collection of the Department of Geology of the British Museum (Natural History) at London is very remarkable as its bulla shows a ridge as well as a groove. The rostral part of both bullae shows a low ridge or crest which rostrally terminates near the extremity of the process in which the bulla is prolonged, and which process lies on the medial side of the *ostium tympanicum tubae*. Just on the lateral

side of this ridge lies a groove which runs from the rostral point of the bulla toward the caudolateral part, terminating in the stylomastoid foramen, on the lateral side of the place where paroccipital process and bulla touch each other. Caudalward this groove becomes deeper and deeper, and assumes a resemblance to a suture-like structure.

Neither the six skulls of *Icticyon venaticus* Lund in the collection of the department of recent mammals of the British Museum nor the skull in the Leiden Museum show these features so well developed; none of them shows a distinct ridge or groove or rough line, and at all events no suture-like structure. The indication of the complex structure of the bulla is not obvious, one young skull only showing a shallow groove perforated by a row of minute openings probably for nutritive blood vessels, but showing no rough line or suture-like structure.

In my opinion it is not impossible that this suture-like structure may be the remnant of a real suture between the tympanic and the entotympanic. In that case the conditions in *Icticyon* would differ from those in other recent Canidae and would agree more with those in some fossil Canidae (*Pliocyon*, Van der Klaauw, 1925). In the recent *Canis*, however, the entotympanic ossifies from without the tympanic (Van Kampen, 1904, pp. 44, 194; 1905, pp. 365, 524) which thus on the above mentioned supposition would not be the case in *Icticyon*. At all events this interpretation would not apply to the caudal portion of the entotympanic, since the entotympanic in *Icticyon* either shows its own center of ossification, or its caudal portion ossifies from without the rostral portion. Secondly in the recent *Canis* the external groove corresponds to the septum in the bulla (Van Kampen, 1904, p. 193; 1905, p. 523), but as this septum morphologically does not agree with the *septum bullae* in the Felidae, its course cannot exactly coincide with the boundary of tympanic and entotympanic. If my above mentioned supposition about the suture-like structure is correct, the groove on the bulla of *Icticyon* would have both a course and a meaning different from that in *Canis*. It is worth mentioning that Van Kampen notes that he has not investigated whether or not in *Icticyon* the course of the external line corresponds to that of an internal septum.

TAPIRUS

Parker (1882, p. 776, pl. LIX, fig. 9) mentions a young male Indian Tapir, and states that: "Between the tympanic and periotic, on the lower side, is a flat, somewhat curved fibro-cartilage (Plate LIX, fig. 9, ty'), which passes posteriorly into a mass of fibrous tissue, in which is imbedded a very definite os bullae (o.b);" this ossification "remaining in a rudimentary condition." Van Kampen (1904, p. 246; 1905, p. 579) not knowing of Parker's discovery, could not find a free entotympanic in his dry skull material. Accordingly he concluded that a free very loose entotympanic which fills the rather broad fissure between the medial side of the tympanic and the ventral side of the high and thick crest on the promontorium and which would disappear during maceration of the skull would be unlikely. More probably the above mentioned crest on the petrosal is, according to Van Kampen, an entotympanic fused with the petrosal, the boundary with the petrosal, however, being marked by a very shallow groove only.

As Van Kampen's material did not show a free entotympanic, and as Parker

neither mentions nor figures the petrosal with or without its crest, a reinvestigation seems worth while.

I examined 32 skulls of *Tapirus* and *Tapirella* at London, and 19 skulls at Leiden. In the majority of this material the tympanic was absent (Parker, 1882, p. 776 notices that the tympanic "is rarely seen in dry skulls"), in many skulls the same was also the case with the petrosal. Where present the crest on the promontorium was always firmly fused with the petrosal and where present the above mentioned cleft was always free from tissue; in one of the London skulls only it showed on one side dried soft parts in which however no distinct entotympanic could be discovered.

CONCLUSION

As a general summary of these investigations we can say that for those mammals which (according to investigations on young material of these species or of nearly related ones, in which both the soft parts and the cartilage are preserved) possess a distinct complex bulla, the results are very disappointing, notwithstanding the very rich material in a number of important museums. Thus indirectly it proves the importance of investigations on material in which the soft parts are preserved, especially of those too much neglected periods of life, the late-foetal, new-born and very young.

LITERATURE CITED

HUXLEY, T. H. 1880. On the cranial and dental characters of the Canidae, Proc. Zool. Soc. London, 1880, pp. 238–288.

KAMPEN, P. N. VAN. 1904. De tympanaalstreek van den zoogdierschedel. Acad. proefschrift Amsterdam, pp. I–XII, 1–379.

——— 1905. Die Tympanalgegend des Säugetierschädels. Morpholog. Jahrbuch, Bd. 34, pp. 321–722.

KLAAUW, C. J. VAN DER. 1922a. Ueber die Entwickelung des Entotympanicums. Academisch proefschrift Leiden, 1922, pp. I–X, 1–50, 4 pls.

——— 1922b. Ueber die Entwickelung des Entotympanicums. Tijdschr. d. Ned. Dierk. Ver. (2), Dl. XVIII, Afl. 2, pp 135–176, Tav. II–V.

——— 1924. Over de ontwikkeling van de tympanaalstreek bij eenige zoogdieren. Nederl. Tijdschr. voor Geneeskunde, 68e jaargang, 1924, 2e Helft, no. 15, pp. 1922–1926. Also in: Werken van het genootschap ter bebordering van natuur–, genees- en heelkunde te Amsterdam, 2e serie, Dl, XI, afl. 2, 1925, pp. 294–298.

——— 1925. On the auditory bulla in some fossil mammals, with a general introduction on this region of the skull. Will appear in the Bulletin of the American Museum of Natural History.

——— 1929. On the development of the tympanic region of the skull in the Macroscelididae. Zool. Soc. London, 1929, pp. 491–560, pl. 1, figs. 25.

PARKER, W. K. 1874. On the structure and development of the skull in the pig (Sus scrofa). Phil. Trans. Roy. Soc., vol. 164, London, 1874, pp. 289–336.

PARKER, W. N. 1882. On some points in the anatomy of the Indian tapir (Tapirus indicus), Proc. Zool. Soc. London, 1882, pp. 768–777, pls. LVIII, LIX.

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DISTRIBUTION AND HABITS OF THE THREE-BANDED ARMADILLO (TOLYPEUTES)[1]

By Colin Campbell Sanborn

[*Plate 4*]

The existence of three-banded armadillos in South America has been known for over three hundred years. During this time three species have been described, but no definite type localities have been fixed for them and the limits of their ranges have not been worked out. References in the literature are numerous but frequently vague or but repetitions of earlier observations. Efforts to straighten out the relationships are set forth in this paper, with the hope that they may be of some help to future workers.

The three-banded armadillo was given the name *Dasypus tricinctus* by Linnaeus in his tenth edition, and in his sixth edition his only reference was to Seba. Illiger, in 1811 proposed the present generic name of *Tolypeutes*. Geoffroy described another species in 1847, which he called *Tolypeutes conurus*, but which now bears the name *T. matacus*, based on Desmarest's name for the *Tatou mataco* of Azara. A third species, *Tolypeutes muriei*, was named by Garrod in 1878, from the pictures and description by Dr. James Murie and a specimen in the British Museum.

Of the original species, *tricinctus*, I have been able to find records of but half a dozen specimens. Not one of these has any definite history. Geoffroy gives no locality for his specimen; Burmeister bought his in Geneva; and the four in the British Museum were purchased from dealers. The only definite locality we have for the occurrence of this animal is in Piso and Marcgrave's report. Georg Marcgrave went as naturalist on the military expedition of Count Johann Moritz, who in 1637, with a Dutch army, captured the states of Sergipe, Pernambuco, Itamarica, Parahyba, Rio Grande do Norte, and Ceara. In the report is the description of a three-banded armadillo with five toes. There are also two crude, but easily recognized, drawings of the animal. In 1817, Lichtenstein, who had studied the plates, said that there was not the least doubt that these drawings referred to the *Dasypus tricinctus* of Linnaeus. Geoffroy and Burmeister both claimed that *tricinctus* came from Brazil. Oldfield Thomas has suggested Surinam as the type locality, doubtless because many other of Seba's animals came from there.

[1] Published by permission of the Director, Field Museum of Natural History, Chicago.

Seba, however, gives no locality for his specimen and there are no records of the animal's occurrence in Guiana. With Marcgrave's report as evidence, it seems more suitable that Pernambuco, Brazil should be designated as the type locality of *Tolypeutes tricinctus* Linnaeus.

From descriptions, *Tolypeutes tricinctus* is undoubtedly a good species. It may be known by the following characters, ascribed to it by Garrod: Thirteen or fourteen rows of scutes on the posterior shield; cephalic shield shorter than the length of the anterior shield and more than half as long as the length of the posterior shield; whole tail flattened from above downwards; five toes on the front feet; eight teeth on each side, above and below. The skull has a bony prominence above each orbit, which he does not mention. There are other characters ascribed to it but I have given here only the ones of which I could find no trace or suggestion in a series of *matacus*.

In 1847, when Geoffroy described *Tolypeutes conurus*, (= *matacus*) he gave Santa Cruz de la Sierra, Bolivia, as the type locality. In 1919, when Dr. W. H. Osgood showed that Desmarest's name *matacus* had priority over *conurus*, he did not designate a type locality for *matacus*. While Azara included the three-banded armadillo in his work on the mammals of Paraguay, he clearly states in the introduction to the account of *Tatous* that it does not occur in Paraguay. He gives the range as Tucuman and the Pampas of Buenos Aires and southward from the 36th degree. Tucuman, in the Province of Tucuman, Argentina, should therefore be considered the type locality of *Tolypeutes matacus* Desmarest.

Tolypeutes matacus differs from *tricinctus* in having four toes on the front feet, instead of five, and in having nine teeth instead of eight. Exceptions are found in these characters, however. It also has from fifteen to eighteen rows of scutes in the posterior shield. The length of the cephalic shield is equal to or longer than the anterior shield, and less than half the length of the posterior shield. The tail is flattened from the sides, toward the end. The skull does not have the bony prominence over the orbit. I thought that I might have broken this bone off in skinning my specimens, so I carefully removed the skull from an alcholic specimen but found no trace of this bone. This skull had ten teeth in the upper jaw, the anterior pair being very small and placed in the premaxillary bone.

The co-type of *Tolypeutes muriei* was, quoting from Garrod, "presented by Burnett and Fitzroy, and therefore must have probably come from some part of the coast of La Plata or Patagonia." As the *Beagle*

FIG. 1. DISTRIBUTION OF THE GENUS TOLYPEUTES. 1–2, TOLYPEUTES TRICINCTUS MURIEI; 3–9, TOLYPEUTES TRICINCTUS MATACUS; TOLYPEUTES TRICINCTUS TRICINCTUS

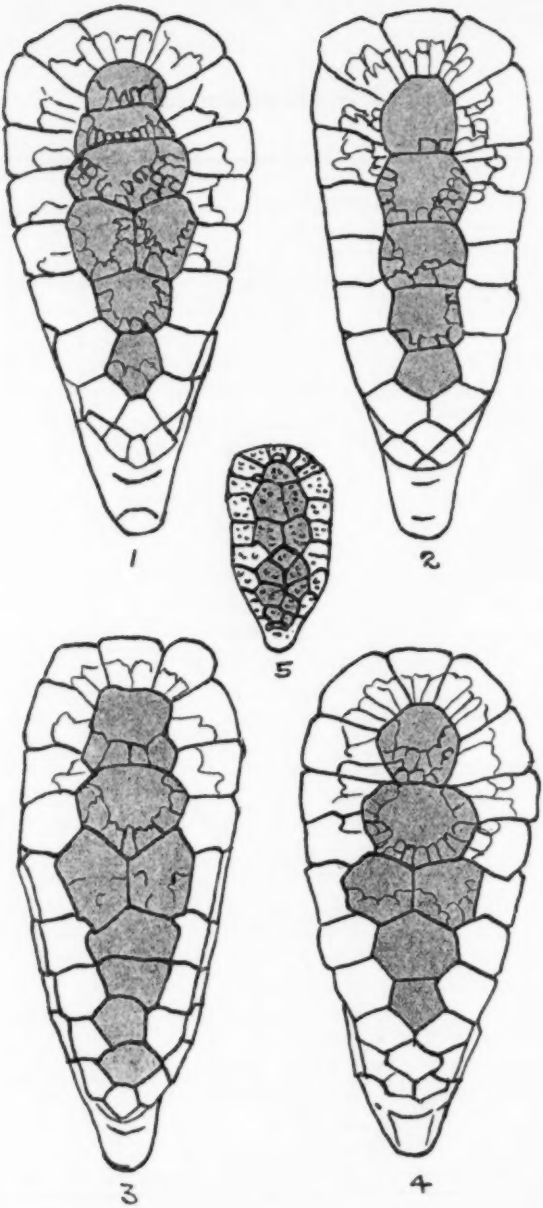


FIG. 2. CEPHALIC SHIELD PATTERNS OF FIVE SPECIMENS OF TOLYPEUTES TRICINCTUS MATACUS FROM DESCALVADOS RANCH, MATTO GROSSO, BRAZIL. NATURAL SIZE

stopped at Bahia Blanca, Argentina, where specimens have been taken since, I propose this as the type locality of *Tolypeutes muriei* Garrod.

Tolypeutes muriei was based on the pattern of the cephalic shield, a very variable character. In all other known respects it resembles *matacus*. Garrod (P. Z. S., 1878, p. 223, fig. 1) shows the patterns of the cephalic shields ascribed to the different species. Lahille, who had twenty specimens from the southern part of the Province of Buenos Aires, said that these agreed with *matacus*. There are records of specimens agreeing with *muriei* from close to the type locality of *matacus*. Figure 2 is of the cephalic shields of five specimens of *matacus* from the same locality in Matto Grosso, Brazil, and shows the great variability of this character. Number 5 is of an embryo and agrees with the pattern given for *tricinctus*. Dr. Murie's specimen of *muriei* had three toes on the front feet but the co-type had four. All of Lahille's specimens had four. On the other hand one specimen that I collected in Matto Grosso had but three. Until a large series of *matacus* and *muriei* are available for comparison, the validity of *muriei* can not be definitely settled.

The map shows the known distribution of *Tolypeutes* today, based on specimens and published records. An explanation of the figures on the map, follows:

1. Carmen de Patagones, Argentina. Three carapaces with one skull in the United States National Museum, Washington.

2. Between Bahia Blanca and Villarino, on the Rio Colorado, Argentina, Twenty specimens in the Museo de La Plata, Argentina, mentioned by Lahille.

3. San Luis, Argentina. Burmeister had two specimens from here, where Brehm's Tiereleben states that it is common.

4–5. Los Sarmientos and Lavalle, Argentina. One carapace and one skull in the American Museum of Natural History, New York, collected by Miller and Boyle, are supposed to be from these localities.

6. 110 kilometers west of Puerto Pinasco, Paraguay. One specimen in the United States National Museum, Washington, collected by Dr. Alexander Wetmore, is the only record for Paraguay.

7. Tarija, Bolivia. Grandidier had two specimens from here. One is the type of *Tolypoides bicinctus* which is apparently only a two-banded specimen of *matacus* just as Coloma's animal, *Tolypeutes quadricinctus*, was a four-banded specimen of *trincinctus*.

7a. Santa Cruz de la Sierra, Bolivia. The type of *conurus*, now in Paris, came from here. Two specimens in the Field Museum of Natural History are from here, and one in the British Museum is from "Bolivia."

8. Descalvados Ranch, Rio Paraguay, Matto Grosso, Brazil. The Field Museum of Natural History has eight specimens from here, and The Colorado Museum of Natural History, Denver, has one.

9. Caicara, Campo do Marco, Mouth of the Rio Jauru, Matto Grosso, Brazil. Natterer collected five specimens here in 1825. Neither the Roosevelt expedition nor the Commissao Rondon found *Tolypeutes* north of Natterer's locality; nor did H. H. Smith or Alphonse Robert find it during their work at Santa Anna do Chapada.

All these records are of *matacus* and *muriei*. There are six other specimens of *matacus* in the British Museum, two in La Plata, and one in Paris; also one specimen in Paris and three in Berlin, of *Tolypeutes*, species not identified. None of these specimens has any history. These, with the six referred to *tricinctus*, make a total of 58 known specimens.

10. Pernambuco, Brazil.

I wish to thank the curators who have permitted me to examine specimens and those who have reported the presence or absence of this genus in their collections. I am indebted to Mr. Herman Hinrichs of the Field Museum of Natural History, for the drawings.

The status of the forms of *Tolypeutes* may be summarized as follows:

Tolypeutes tricinctus tricinctus (Linnaeus)

Dasypus tricinctus Linnaeus, Syst. Nat. ed. 10, **1**, p. 51, 1758.

Dasypus quadricinctus Linnaeus, Syst. Nat., ed. 10, **1**, p. 51, 1758—based on a four banded specimen of *tricinctus*.

[*Tolypeutes*] *tricinctus* Illiger, Prodromus Syst. Mamm. et Avium, p. 111, 1811; Thomas, P. Z. S. Lond., p. 141, 1911 (suggested type locality, Surinam).

Proposed type locality.—Pernambuco, Brazil.

Range.—Northeastern Brazil.

Six known specimens, without definite locality.

Tolypeutes tricinctus matacus (Desmarest)

Tatou huitième ou Tatou mataco Azara, Quad. Paraguay, **2**, p. 197, 1801.

Loricatus matacus Desmarest, Nouv. Dict. d'Hist. Nat., **24**, Tab. Meth. Mamm., p. 28, 1804.

Tolypeutes conurus Geoffroy, Rev. Zool. Paris, p. 137, April, 1847; Comptes Rendus, **24**, p. 575, January-June, 1847—Type locality, Santa Cruz de la Sierra, Bolivia.

Tolypoides bicinctus Grandidier, Bull. Mus. Hist. Nat., Paris, p. 370-372, 1905—based on a two-banded specimen of *matacus*.

Tolypeutes matacus Osgood, Jour. Mamm. **1**, p. 33, 1919.

Proposed type locality.—Tucuman, Province of Tucuman, Argentina.

Range.—From Santa Cruz de la Sierra, Bolivia, and southern Matto Grosso, Brazil, south through western Paraguay, and Argentina, to San Luis, Argentina.

This is the commonest form, there being about forty known specimens.

Tolypeutes tricinctus muriei Garrod

Tolypeutes muriei Garrod, P. Z. S. Lond., p. 223, 1878.

Proposed type locality.—Bahia Blanca, Argentina.

Range.—Carmen de Patagones, Argentina, north possibly to Buenos Aires. About twenty-five specimens; doubtfully distinct from *matacus*.

HABITS

While a member of the Captain Marshall Field Brazilian Expedition of Field Museum of Natural History, I spent two months at Descalvados Ranch, on the upper Paraguay River, in Matto Grosso, Brazil, where the three-banded armadillo was rather common. My notes were made on nine specimens, eight of which were collected in the course of hunting for larger mammals.

The three-banded armadillo was found in the open grass land, sometimes marshy, which occurs between the scattered stretches of forest. The first one I saw ran across the road in front of my horse and stopped in some bushes alongside me. I reached for my pistol, but my Indian guide told me to pick it up by the back, which I did. Two others were caught in steel traps and six more were discovered by one of the dogs.

One day while riding through a patch of open woodland, I saw a large hole in the base of a termite nest, probably made by an ant-eater, and filled with grass and leaves. As we were trailing a tapir at the time, I could not stop, but my hunter told me that it was the nest of the three-banded armadillo. This Indian, who made hunting a profession, had lived on this ranch about fifty years, and I found him well acquainted with the animals of the region and accurate in his information about them. Some authors say that this armadillo digs holes but most of them take the opposite view. I never saw the three-banded armadillo try to escape by digging, and the live ones that I kept in a box always tried to climb out but never to scratch their way out of the box.

I often had to keep my specimens a number of days before preparing them, so all the stomachs that I examined were empty. Those in captivity are reported as eating fruits, leaves, boiled rice, soft bread in tea or milk, ant eggs, meal worms, and one picked up ants from the floor of its cage. One lived for fifteen months in the London zoo and another for eleven years in Berlin.

Out of a pack of seven dogs, there was but one, a year old puppy, who ever paid any attention to this armadillo. When he discovered one, he barked just once and then stood by it until we returned to pick it up. He showed no interest in one except to call our attention to it. The other dogs never went near one or showed the slightest curiosity about it. On the other hand I saw them attack and kill both the six- and nine-banded armadillos. All specimens discovered by the dog were lying

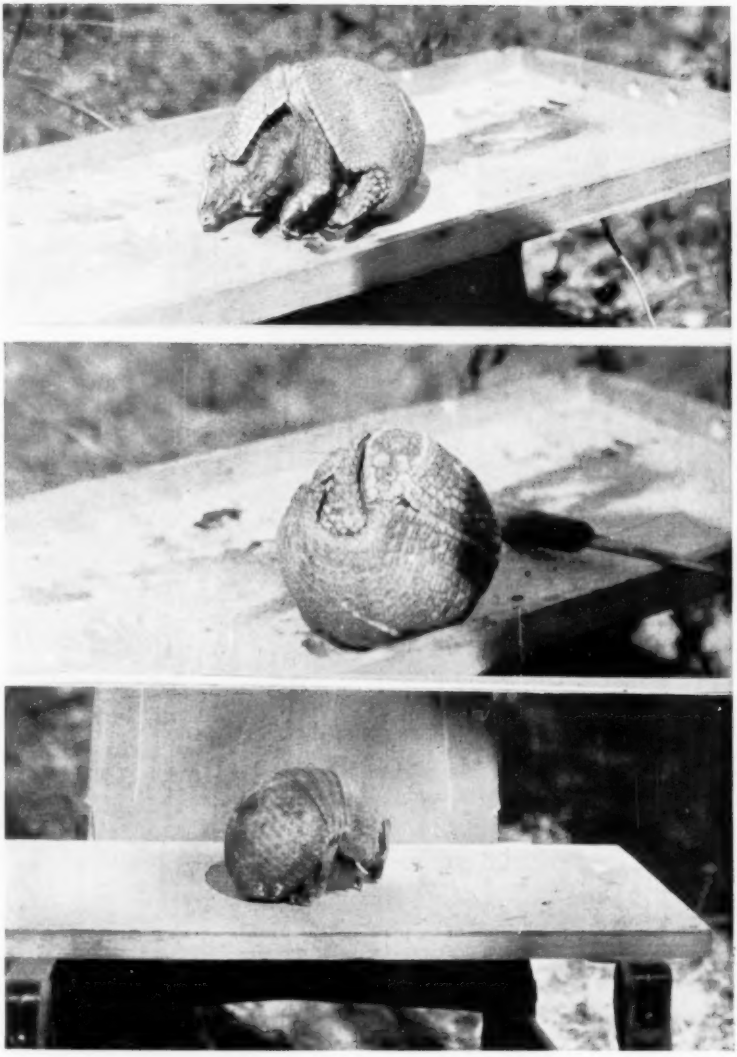
on their sides with their shells partly open. They held this position until touched on the abdomen or chest and then they snapped together like a steel trap. It was with difficulty that I pulled a stick from between the edges of the shell. Any animal that had its paw or nose or lip pinched in this trap would undoubtedly be very careful with this species of armadillo thereafter. What interested me was that an animal, given absolute protection from the largest carnivores of its range through passive resistance, should also be able, and apparently wait the chance, to inflict a painful reminder of itself on its annoyer.

When the animal had been left alone for a short time, it unfolded and started off, walking on the tips of its long front claws. The animal in plate 4 is not fully unrolled as the tail is still hidden under the shell.

A well developed foetus was taken from a female on July 2, and one less developed from another on August 4. Three foetuses were found in a six-banded armadillo (*Euphractus*) on July 7. It would seem possible that an animal so well protected as the three-banded armadillo would need to have but one young to hold its own. I saw shells of the six- and nine-banded armadillos that had been eaten by jaguars and red wolves, but I never saw the remains of a three-banded armadillo.

When man, who eats its flesh, comes into its life, its passive resistance may prove its extermination. In the case of *tricinctus*, where only six specimens have been taken in nearly three hundred years, this may have already happened.

Field Museum of Natural History, Chicago, Illinois.



UPPER: FIRST DEFENSE; POSITION TAKEN WHEN FOUND BY DOG
MIDDLE: SECOND DEFENSE; ROLLED INTO A BALL
LOWER: PARTLY UNROLLED AND WALKING AWAY

UNIV. OF MICH.

A REMARKABLE WOODCHUCK SKULL

By Malcolm Rutherford Thorpe

[*Plate 5*]

Recently the Peabody Museum of Natural History of Yale University acquired by gift the skull and jaws of a very unusual specimen of woodchuck, *Marmota monax* (Linnaeus), Cat. No. 0945. The animal was killed near Woodsfield, Ohio, and the skull collected and sent to the Museum by Herbert R. Mooney of that city.

The outstanding characteristic of this specimen is the evidence of unrestricted development of the upper and lower incisors. These teeth apparently never opposed each other and, as the animal is fully adult, it is evident that they grew unhampered during the lifetime of the individual. The upper incisors bear to the left and the lower to the right. The left upper incisor has a total length along the outer edge of the curve of 120.5 mm. ($4\frac{3}{4}$ inches), or one and one-quarter revolutions. The right upper incisor was apparently deflected toward the left before emerging from the alveolus, so that as the tooth grew it curved inward, then upward, penetrating the left maxilla and left turbinal, and then outward and downward, reëntering the mouth through the right side of the alveolus of the left incisor. This tooth has made slightly more than a complete revolution and is considerably shorter than its mate, probably because of the resistance it encountered in passing through the bones of the anterior part of the skull. The left incisor forms an open spiral while the right is considerably more closed.

The lower incisors, trending toward the right, have a maximum length of 89 mm. ($3\frac{1}{2}$ inches). They have worn away the anterior portion of the right nasal bone, showing that the animal had some difficulty in opening its mouth. However, Mr. Mooney says that the animal was fat, quite normal otherwise, and showed no signs of not being able to get its food. It is also evident that the left upper incisor pressed against the antero-external part of the left ramus.

The law that the incisor teeth of all rodents are curved, and that the upper ones describe a larger segment of a smaller circle and the lower a smaller segment of a larger circle is well exemplified in this specimen. While rodent skulls showing abnormal growth of one or two incisors are not uncommon, it seems that those showing abnormal growth of all four incisor teeth among the Simplicidentata are fairly rare.

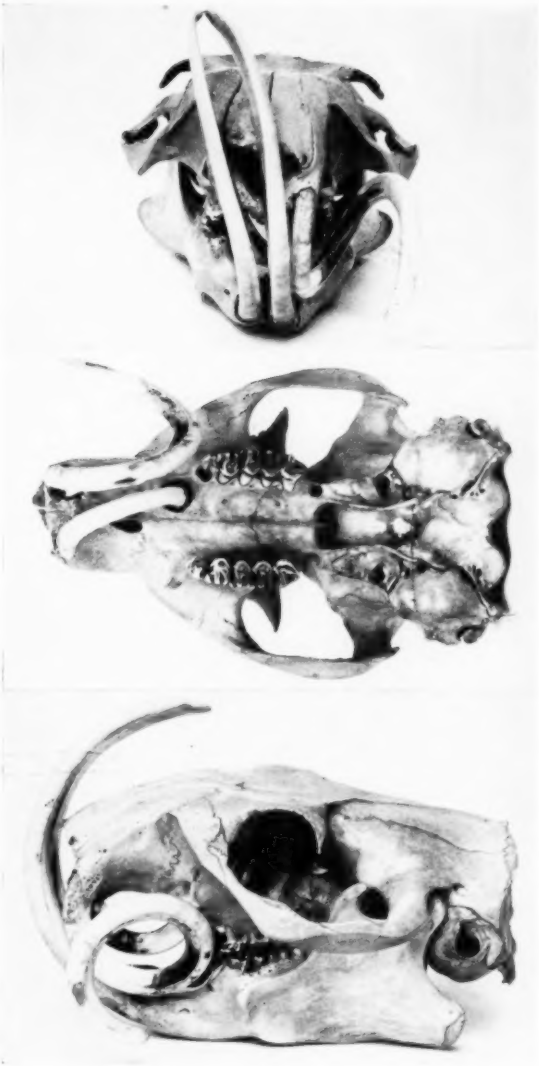
In nearly all cases it has been supposed that the animals having this

dental disturbance, suffered greatly and died in agony. However, I believe the growth of these teeth to be relatively slow, thus allowing for bone absorption and readjustment of the nervous system, so that the animal is not suffering intense pain, and that starvation is the result only in extreme cases where the incisors penetrate the skull in such manner that they cause the jaws to be locked.

The woodchucks, as we know, subsist mainly on grass and clover, which they triturate by means of a backward and forward movement of the jaws. In this specimen this movement was restricted to some extent because of the lower incisors rubbing against the nose and the upper incisors against both the lower jaw and the lower incisors near their alveoli.

As to the cause of the condition in this specimen I cannot be sure. There seems to be no evidence of any injury to the bones of the skull or jaws. There is a malformation of the right upper incisor socket which has caused the offset of that tooth, so that it could not oppose the lower incisor, and the growth of this malformed tooth prevented the apposition of the left pair of incisors. Probably this maladjustment was congenital. The left lower incisor is a trifle shorter, about 3½ mm., than the right, which may indicate that the left pair did oppose for a very short period in early life but that very soon the growth of the right upper incisor caused the forward protrusion of the lower jaws, so that there was no further possibility of these teeth opposing.

The peculiar condition of the incisor teeth would immediately suggest that there was something abnormal about the hinging of the jaws and the occlusal relations of the molars. These features were found on comparison with other woodchuck skulls to be perfectly normal. The crowns of the cheek teeth are well worn, about to the level of the roots on the last molars.



UPPER: FRONT VIEW OF SKULL AND JAWS OF MARMOTA MONAX (LINNAEUS). NO. 0945, PEABODY MUSEUM OF NATURAL HISTORY. NOTE ANTERIOR PART OF RIGHT NASAL BONE

MIDDLE: PALATAL VIEW OF SKULL SHOWING RIGHT UPPER INCISOR WHERE IT PENETRATED LEFT MAXILLA. NOTE ASYMMETRY OF ANTERIOR PART OF SKULL

LOWER: LEFT SIDE OF SKULL AND JAWS, SHOWING EXTREME DEVELOPMENT OF UPPER AND LOWER INCISORS

UNIV. OF MICH.

MAMMALS COLLECTED ON THE ISLAND OF KOH TAU OFF THE EAST COAST OF THE MALAY PENINSULA

By H. Harold Shamel

The mammals listed in this paper were collected by Dr. Hugh M. Smith on the island of Koh Tau off the east coast of the Malay Peninsula. According to Dr. Smith, this island is the most remote Siamese island in the Gulf of Siam, and is situated about forty miles from the coast. It is nearly four and one-half miles long, mountainous, and wholly uninhabited. The specimens were collected in September and December of 1926, January of 1927, and September and December of 1928. So far as known they are the first mammals ever collected on the island. Among them are two forms new to science.

Tupaia lacernata kohtauensis subsp. nov.

Type.—Adult male, No. 253446 U. S. National Museum from the Island of Koh Tau, collected September 19, 1928 by Dr. Hugh M. Smith.

Characters.—Differs from the other known subspecies of *Tupaia lacernata* in its darker color.

Color.—The hairs of the lower back are smoky black at their base; this black area is followed by a band of buff; the tips of the hairs are black. The buff band is much narrower than either of the dark bands, the black tips comprising about one half the length of the hair, which gives the back, especially in certain lights, a black glossy appearance noticeably darker than the tail. In other specimens there is a succession of black and buff bands of about equal width, and the back is not darker than the tail. The black tips become much shorter on the sides of the body, as well as toward the neck and about the forehead, face and shoulders, and the buffy rings become more conspicuous and somewhat broader on the sides, giving more buff around the sides of the head and the sides of the shoulders, and a streaked buff appearance to the sides. The crown of the head is darker. The rostrum is finely grizzled buff and black; a buffish ring around each eye, indistinct above, more plainly marked below. The feet are covered with very short brown hairs tipped with buff.

On the underparts is an area of long, straight, rusty white hairs. This area, which begins on the neck, narrows wedge fashion to a point a little below the center of the abdomen, and is bordered on each side by a band of fine fuzzy hairs that are darker at their bases. There is a lighter streak on the thighs where the upper fur meets the under. Shoulder stripe of light buff present. The tail is lighter than the back and has a succession of black and buff rings on the individual hairs, which gives to the tail a grizzled look rather than a look of being ringed. It is lighter underneath than on top, with the characteristic lighter streak down the center of the underside. Mammary glands four (2-2).

Skull.—The skull differs from that of *T. lacernata lacernata*, *T. lacernata wilkinsoni*, and *T. lacernata raviana*, with which it has been compared, in its smaller size, shorter and blunter rostrum, and smaller teeth. It seems to be approxi-

mately the same size as *T. lacernata obscura* from the Great Redang Island off the east coast of the Malay Peninsula, judging from the measurements of this form given by Lyon in his "Treeshrews," 1913.

Measurements.—Skull, total length, 48.5 mm.; condylobasal length, 45.4 mm.; interorbital breadth, 14.0 mm.; zygomatic breadth, 26.0 mm.; breadth of braincase, 19.2 mm.; length of nasals, 14.5 mm.; maxillary toothrow, 17.2 mm. (from canine to m^2); mandibular toothrow, 15.0 mm. Skin measurements taken from dry skin; length of head and body, 200.0 mm.; length of tail, 182.0 mm.; hindfoot, 44.5 mm.

Specimens examined.—Eleven, all from the Island of Koh Tau; 5 collected December, 1926, 2 collected January, 1927, and 4 collected September 1, 1928.

Remarks.—This subspecies is nearest *T. lacernata obscura* in size. Both these forms are found on islands off the east coast of the Malay Peninsula. Redang Island, the type locality of *T. lacernata obscura*, is located about one third the length of the peninsula from the southern point, and Koh Tau about two thirds. The blackish back of this subspecies will readily distinguish it from any other member of the *lacernata* group.

Pteropus hypomelanus geminorum Miller

1903. *Pteropus geminorum* Miller, Smith. Misc. Coll., vol. 45, pp. 60–61, November 6, 1903.

1912. *Pteropus hypomelanus geminorum* Andersen, Catal. Chiroptera British Museum, vol. 1, pp. 106–107, 1912.

Two adult specimens, a male and a female.

The Mergui Archipelago, the type locality of *P. hypomelanus geminorum*, is on the other side of the Malay Peninsula from Koh Tau and a little farther north. The bats from Koh Tau and those from the Mergui Archipelago are exactly alike in measurements and color markings, except that the gray on the back of the Koh Tau specimens is a little brighter silvery gray, especially on the back of the female skin. This specimen lacks the faint buffish look to the silver hairs which the animals from the Mergui Archipelago show. The female skin from Koh Tau is grayer around the top and the sides of the head. The gray extends on to the throat and neck. The skins from the Mergui Archipelago, however, appear to have been dusted with some kind of yellow powder, which I believe accounts in part for their somewhat yellowish color on the back, though not on the head.

Sciurus caniceps helvus subsp. nov.

Type.—Adult male, skin and skull, No. 253433 U. S. National Museum, collected on the Island of Koh Tau off the east coast of the Malay Peninsula, September 17, 1928, by Dr. Hugh M. Smith.

Chacacters.—A small *caniceps* most nearly related to *Sciurus caniceps inexpectatus* Kloss from Koh Lak on the east coast of the Peninsula, but size distinctly smaller, hind foot 40.2–43.4 mm. s. u. instead of 45.0–48.5 mm. s. u.; condylobasal length of skull, 41.5–44.8 mm. instead of 45.3–46.2 mm.

Color.—Gray phase: The hairs on the back have a broad smoky black area at their base; this black area is followed by four alternate bands of buff and black:

the tips are black. The sides of the neck and the region just back of the shoulders are washed with yellow. This yellow extends along the lower edge of the sides back on to the underside of the thighs. The throat and belly are grayish. The hands, forearms, hindfeet, forehead, and sides of head are gray; the upperside of the thighs is colored like the back. The individual hairs of the tail have a succession of black and buffish bands, and the tips of the hairs are black. The tip of the tail is black. The general color of this squirrel is gray faintly washed with pale yellow.

Yellow phase: Two skins, a male and a female collected at the same time as the type, are in the yellow phase. They are entirely yellow (yellow ochre, Ridgway 1912) except for the feet and forelegs, which are light gray lightly washed with yellow. The yellow extends the full length of the tail to the black tip. The individual hairs of the tail have a succession of black and yellow bands, while the tips of the hairs as well as the tip of the tail are black. The hairs of the back have a broad black band at their base with a very faint narrow yellow one near the base of the black one. The black band is followed by a broad yellow band, and the individual hairs are faintly tipped with black.

Skull.—The skull is much smaller than that of *Sciurus caniceps inexpectatus;* greatest length, 45.8–48.8 mm. as against 53.5–55.5 mm. in *S. c. inexpectatus;* zygomatic breadth 25.8–29.2 mm. as against 30.0–32.8 mm.; maxillary toothrow, 9.2–9.6 mm. as against 10.5–11.0 mm.

The above are the extremes of measurements of 7 skulls of *Sciurus caniceps helvus,* and 4 skulls of *Sciurus caniceps inexpectatus.* The latter are those given by Kloss in his description of the type.

Measurements.—There are no field measurements of this specimen, but in the dry skin the tail is 180.0 mm. and the hindfoot 44.8 mm. (including claw). Total length of skull, 48.8 mm. (45.8–48.8); interorbital breadth, 18.5 mm. (15–17.4); zygomatic breadth, 29.0 mm. (25.8–29.2); breadth of braincase, 22.5 mm. (21.0–22.6); length of nasals, 14.0 mm. (13.4–14.0); maxillary toothrow, 9.5 (9.2–9.6); mandibular toothrow 9.0 mm. (9.0–9.6). The measurements in parenthesis are the extremes of 7 other skulls.

Specimens examined.—Thirteen, 7 collected in September, 1928, and 6 collected in December, 1926, all from the Island of Koh Tau.

Remarks.—This squirrel is a small *caniceps,* and is most nearly related to *Sciurus caniceps inexpectatus* (Kloss) 1916[1] from Koh Lak. The Koh Lak form was redescribed in 1917[2] by Nils Gyldenstople under the name *S. caniceps helgei.* The gray phase is like that of *S. c. inexpectatus.* The yellow phase is not known in *S. c. inexpectatus.* As compared with specimens of true *caniceps,* in the yellow phase, from the general region of Bangkok, the new form differs in its much lighter color—yellow ochre, instead of the mars yellow (Ridgway 1912) of true *caniceps.* The yellow extends the full length of the tail to the black tip, while in *S. c. caniceps* the yellow extends on the base of the tail for only a short distance. The yellow

[1] *Sciurus epomophorus inexpectatus,* Kloss, Journ. Nat. Hist. Soc. Siam, II, p. 178, 1916. *Sciurus caniceps inexpectatus,* Kloss, Journ. Nat. Hist. Soc. Siam, III, p. 363, 1919.

[2] *Sciurus caniceps helgei,* Gyldenstople, Kungl. Svenska Vetenskapsakademiens Handlingar, Band 57, No. 2, p. 34, Feb. 2, 1917.

covers the hind legs even on the under side in the animal from Koh Tau, while, on the contrary, in true *caniceps*, the hind legs are gray both above and below like the front legs.

Rattus rattus subsp.

Four specimens, one collected December, 1926 and three collected in September, 1928. These specimens represent a form closely related to *Rattus rattus klumensis* Kloss from Koh Klum Island.

Division of Mammals, United States National Museum.

A NEW ALASKAN MICROTUS

By Olaus J. Murie

Among some specimens collected on the western end of the Alaska Peninsula and adjacent islands in the summer of 1925, are 28 *Microtus* taken on Amak Island easily distinguishable from comparable specimens of neighboring forms. Amak Island, about four square miles in area, lies in Bering Sea about 12 miles off the coast of Alaska Peninsula, opposite Izembek Bay. The island consists chiefly of a high cone of moss-covered lava, with a definite lowland area on the south side. The mice were trapped near the beach on this lowland.

Microtus amakensis, sp. nov.

Type.—From Amak Island, Bering Sea, Alaska. No. 246449, ♂ adult, U. S. National Museum (Biological Survey collection), collected by Donald H. Stevenson, July 8, 1925. Original number, 80.

General characters.—Resembles *M. kadiacensis* and *M. popofensis*, but is paler in color, with heavier, well-ridged skull and with more flattened occipital surface.

Color in July pelage.—Upper parts uniformly dull tawny or cinnamon brown; feet and tail silvery gray, tail with little trace of dusky above in adults; whole underparts pure white or slightly creamy. Young and immature duller in color with distinctly blackish upper surface of tail.

Skull.—Heavy, angular, well ridged, with occipital surface flat, almost at right angles to the axis of the skull, and with short incisive foramina.

Measurements.—Type: Total length, 190 mm.; tail, 51 mm.; hind foot, 22 mm. *Topotypes:* Average of four adult males: 190 (198–179); 49 (53–44); 21.75 (22–21). Average of eleven adult females: 181 (192–168); 48 (53–38); 21.3 (22–20). *Skull of type:* Basal length, 29 mm.; nasals, 8.4; zygomatic breadth, 17.4; mastoid breadth, 13.7; alveolar length of upper molar series, 7.1.

Specimens examined: 28 from Amak Island, Alaska, collected by O. J. Murie and Donald H. Stevenson in July, 1925.

Remarks: Microtus amakensis is easily distinguished from the neighboring forms, *M. unalascensis, popofensis,* and *kadiacensis,* or from any of the *M. operarius* group. The most obvious cranial difference is the flat occipital surface, as compared with the convex surface of the other forms. The incisive foramina are short and broad, as contrasted with the long, attenuated foramina in the other forms. The audital bullae do not differ strikingly from those of *kadiacensis* or *popofensis,* but are much smaller and narrower than those of *unalascensis.* The anterior ends of the frontals are decidedly wider and the skull is more heavily ridged than in either *kadiacensis* or *popofensis.*

M. amakensis does not differ strikingly in general coloration, from *kadiacensis* or *popofensis* but it is slightly paler and so far as my specimens show does not have the buffy wash on the underparts, which is so prevalent in the latter. The pale color of the feet and especially of the top of the tail distinguish *amakensis* from the others, even the mainland specimens only about 12 miles distant.

GENERAL NOTES

THE EARLY FAUNA OF SANTA CRUZ ISLAND, CALIFORNIA

In working over the vertebrate remains, other than human, that were collected during two years' anthropological work on Santa Cruz Island, certain rather interesting data have been brought to notice. Stratigraphical studies were made of several shellmounds so that the age of the mounds might be roughly estimated. Although detailed study of this fauna will be made later, a preliminary note will be of interest.

Of the mounds studied, only two are very rich in vertebrate remains; the rest have a meager representation of a limited number of species. Among the marine mammals, of special interest is the sea otter (*Enhydris lutris nereis*), because of the great scarcity of its bones. Current opinion leads one to assume that sea otters were very abundant among the Santa Barbara Channel Islands, at least until hunted out by the white man. Numerous authors mention the great abundance of otters among the islands of the Santa Barbara group during the Spanish period in California; but, judging from the number of bones that were recovered from the mounds, it would seem that sea otters were never *very* numerous in this region, or, if numerous, that their use was not favored by the natives. Less than one hundred elements of the sea otter were recovered from all levels of all the trenches, and from all the mounds examined on Santa Cruz Island. This scarcity is particularly noticeable—especially when compared with conditions in the mounds of the San Francisco Bay region.

Seal (*Phoca*) bones, especially the humerus and femur, although all parts were recovered, were found in large numbers at all the island sites and at all levels,

with slight variations in quantity. The age range of the seal is from very young to very old, the natives evidently eating any they were able to obtain. The sea lion is well represented but its bones are by no means as plentiful as those of the seal. Both *Zalophus californianus* and *Eumetopias stelleri* were recovered, the former in greater numbers than the latter. The porpoise appears to rank second to the seals as to quantity and distribution through the different strata, and they were found in all the mounds. Remains of several kinds of large fish, as well as numerous small ones, were discovered in varying amounts in all mounds and at all levels. The bones of the whale were not so numerous at different levels or in different mounds, and their occasional presence was doubtless due to the drifting ashore of dead animals.

Although bird bones were present in practically every strata, they were by no means plentiful either as to species or quantity. It would seem that cormorants were the birds most commonly used, for they were found at all levels: in Site 100 down to eight feet, and in Site 147 down to twelve feet. Other birds found in varying numbers and at irregular levels were the California brown pelican, raven, loons, California murre, fulmar, shearwater, and gulls including western, glaucous-winged, and California. A more extensive study of the bird bones will no doubt reveal many more forms, especially of the smaller shorebirds.

Most unexpected was the occurrence of deer bones at irregular intervals and in the different mounds. The Chumash Indians who inhabited the Santa Barbara region, including the Channel islands, were a maritime group who possessed well-made canoes of planks. In these canoes the Chumash went from island to island and back and forth to the mainland. From the mainland they brought the leg bones of deer, doubtless for their artifacts, since the distal end of the metapodial predominates. These cut-off ends of the cannon bone were found at different levels: in Site 147, located on the southwest side of the island, they were found as deep as eight feet; at Site 100 on the west end, they were found from the one foot level down at least to four and one half feet.

The Santa Cruz Island fox was plentiful on the island during this early period, for fairly complete skulls and considerable assortment of other parts of the skeleton have been recovered. Site 100 was particularly rich in fox elements down as far as the eight foot level. Whether or not the species is like the form living there at the present time is yet to be determined.

There is relatively little sting-ray material from these island mounds. No rodent has been discovered so far, nor have any reptile or amphibian elements.

The bones as a whole are very fragmentary, broken, though not weathered. Especially is this fragmentary condition noticed when compared to the well preserved ones from the Emeryville mound (Oakland, California). Perhaps this fragmentary condition may be attributed partly to the presence of the domestic dog among the Chumash and its apparent absence from the Emeryville mound. The kind of soil in which the bones were buried may be partly responsible for their unusual brittleness.—Edna M. Fisher, *Berkeley, California.*

CALIFORNIA SCIURIDAE IN CAPTIVITY

Instances of gray squirrels kept in captivity to the age of eleven years and chipmunks to eight years of age are worthy of record. In Jamestown, California, I found an old gentleman, Frank G. Harriman, 72 years of age, who has been inter-

ested in taming squirrels since his fifteenth year. At the time of my visit in late August, 1928, he had an eleven year old male California gray squirrel (*Sciurus griseus griseus*), its eleven year old mate, and her sister, and a male offspring of the pair, eight years old. Three years ago a fire destroyed Mr. Harriman's property and only these four grays were saved out of eight. All the chipmunks were lost, ending the eight years of captivity.

Each gray squirrel has a roomy compartment in a screen house. Burlap is hung completely around the outer walls from the eaves down three or four feet, thus leaving open screening about the lower half of the structure. The shade of oaks and the burlap combine to keep temperatures down in summer.

During the daytime Mr. Harriman releases one or another of the grays and gives it the run of the house, or freedom outdoors when he is near. They are exceedingly tame and responsive, but vicious to each other. Two will fight without making a sound and inflict deadly or dangerous wounds. Both father and son are minus tails, while scars are common to all. Distorted digits are suffered by attacks through wire partitions. When the scabies killed most of the gray squirrels of California in 1920 and 1921, Mr. Harriman treated two of his pets that were infected and by a physician's prescription of carbolic acid and sheep dip (twenty-five drops of each added to eight ounces of water) saved them. Large hairless scars remain as evidence.

In a large screen porch on two sides of the residence were eighty-three chipmunks which Mrs. Ross and I identified as the long-eared (*Eutamias quadrimaculatus*). In the spring of 1927, Mr. Harriman trapped twenty-six in a valley near Strawberry, Tuolumne County, California, from which eight young were soon born. These thirty-four lived and eleven litters were born in May, 1928. All mating activity was over within a two-weeks period, as were also the various births of young. Mr. Harriman is quite sure the gestation period is thirty-one days.

The forty-nine young of 1928 are alive, as is the 1927 stock, making a total of eighty-three chipmunks in one room—which is a sight that gives many impressions in a split second.

The old gentleman claims he has never lost a "child" born under his care. The food offered these tiny rodents is amazing. Huge trays of almonds, walnuts and acorns of *Quercus lobata* are always before them. Mr. Harriman usually cracks the tougher nuts. The animals are given rolled oats and ground barley, but prefer seeds of sunflower, cantaloupe, pumpkin, and gourds. In season of peaches these and other fruits, to the animals' special delight, and corn in the milk, are provided in plenty, the latter at the rate of a sack a week. Pomegranates are purchased for the grays. Canned fruits and vegetables are also given occasionally in winter. No regular green food or carrots were mentioned or visible.

We asked Mr. Harriman about taming *Callospermophilus* and he said they never became friendly or tame; this has been our experience with one exception, an adult which allows handling after four months' captivity. The Douglas tree squirrel (*Sciurus douglasii*) will tame if taken young; adults taken wild failed to become tame.

We have found the California ground squirrel (*Citellus grammurus beecheyi*) one of the wildest of caged Sciuridae; even partly grown young remain fearful and are dangerous to handle after weeks of captivity.

Two young Mohave ground squirrels (*Citellus mohavensis*) have proved most novel pets and quite tractable, usually chittering a remonstrance when handled, but rarely biting.

Ammospermophilus is common in pet stores in southern California and makes a good cage squirrel. The stock comes mostly from the Mohave Desert and becomes fairly well domesticated as we have proved with several specimens of that race.—Roland Case Ross, *Los Angeles City Schools, Los Angeles, California.*

OUT-OF-SEASON CACHING BY FOX SQUIRREL

On December 31, 1928, in Forest Hill Cemetery, Ann Arbor, Michigan, I noticed a fox squirrel (*Sciurus niger rufiventer*) pick up a small object, turn it over in its paws several times, then grasp it firmly in the mouth and run to a spot where the wind had swept the fallen leaves into a shallow windrow. Here the squirrel cached the object in the regular way, although, the ground being frozen hard (but still bare of snow), all tamping motions did not serve to sink it below the surface. Leaves were re-scattered over the spot and the animal went about its business. I uncovered the object and found it to be a shagbark hickory nut. Although acorns were still plentiful in spots nearby, hickory nuts were very scarce. The time was 2:30 p.m. The weather was clear, sunny, and cool for the season.

I have under observation almost continually two sets of fox squirrels. One set, composed of a male and female live-trapped from a street shade tree here about the middle of January, 1928, have never, to my knowledge, cached any of their food since, with the exception noted below, although at times they are given enough for three or four days at once. The other set, the property of Mr. and Mrs. Arthur Svihla of the University Museums, have been caged since the age of a few weeks, and during the time I have had them under observation from December 1, 1928, to the present, February 28, 1929, they have always cached in the litter of their cage all food not needed for immediate consumption.

Early in March, 1929, the female squirrel referred to above cached a few hickories in the litter of the cage. This practice was very occasional and I have not observed it during April.

March 6, 1929, I saw a squirrel cache something in a lawn in town. Although I failed to find the object I am sure it must have been an article of food. This occurred shortly before dusk.

March 12, early in the afternoon, I noticed two squirrels cache. One had buried a large pignut hickory; the cache of the other I could not locate.

March 17, at noon, a squirrel cached an object which proved, on being dug up, to be a hickory nut.

April 23, in the afternoon, a cache of a squirrel in a cemetery turned out to be a large white oak acorn, just beginning to sprout.

April 26, about 2 p.m., I saw a fox squirrel cache a small hickory nut.

These observations would indicate that for this species the caching instinct is strongest in the fall, but probably extends over most of the year, at least when there is a surplus of food.—Victor H. Cahalane, *University of Michigan, Ann Arbor, Michigan.*

DEVELOPMENT OF YOUNG RED SQUIRRELS

On August 5, 1927, a female red squirrel, *Sciurus hudsonicus loquax*, was caught alive at Holland, Michigan. As we were travelling by automobile, she was kept in a small cage on the running board. On August 20, she gave birth to five young. They were pink all over, entirely hairless and blind. One weighed 6 grams. When they were 7 days old, a black covering of hair was visible on top of their heads. Their weights, taken when they were 20 days old, averaged 17.28 grams. By this time, they were quite hairy, the hair over the body being brown while that on the head more blackish in color. On September 17, when 28 days old, they averaged 21.24 grams. Their lower incisors had come through but the uppers were not yet visible. All this time they had been kept in a small cage on the running board of the car. By September 18, we had arrived at Ann Arbor and the squirrel family was transferred to a roomy cage. In spite of this, one of the young died on September 19. The eyes of the remaining four opened on September 24 when they were 35 days old. They averaged 23.7 grams when they were weighed on the following day. Their claws were very sharp and they were able to climb up the wire sides of the cage for they were becoming quite active and would often crawl out of the nest box. They were all males. By the time they were 41 days old, they averaged 30 grams in weight. Their upper incisors were just visible at this time. On October 10, the female escaped from the cage and in an attempt to catch her, she was accidently killed. The young were not yet weaned so we brought them up by means of a medicine dropper, feeding them rich milk, usually half cream and half milk to which had been added a little sugar and some cod liver oil. In order to keep them warm during the cold nights, their box was placed near the hot air register. One morning, upon examining the nest box, only three squirrels could be found. After much searching, two days later, the missing squirrel was found down the hot air register pipe, quite warm but very hungry as testified by loud squeaking. He was rescued and after drinking several dropperfuls of milk, went to sleep, apparently none the worse for his experience. When the four young squirrels were 60 days old, they averaged 54.3 grams in weight and were eating solid food. They were given graham crackers, apple and dog biscuits soaked in milk. They were quite lively by this time, playing and tumbling each other about. By the middle of December, their fur had become very red and they were almost as large as adults. Several times we watched them "drum" with their hind feet when they were frightened or nervous.

Another female red squirrel was caught at Ann Arbor on April 23, 1928, and on April 26, she gave birth to four young. These were also pink all over, hairless and blind. They weighed from 7.0 to 8.3 grams with an average of 7.5 grams. One was preserved as a specimen. There were three females and one male, the sex being determined by the greater distance between the anus and the urethral opening in the male. When they were 6 days old, the dorsal surface of the young had become darkly pigmented while the under surface remained pink. By the time they were 9 days old, a very fine coating of black hair was visible on the backs while the hair on the bellies was white. They made a squeaking, chirring noise when disturbed. When 13 days old, the hair had grown thicker and longer especially on the head region which had taken on a reddish tinge. When 16 days old, the dark lateral line was distinct and 8 days later they had become very

hairy and reddish all over except for the white bellies. Their eyes opened on May 23, when they were 27 days old. In opening, the middle of the eyes opened first. At this time, they weighed 43, 45 and 50 grams. Owing to the fact that we were away during the summer, observations were discontinued after June 7. The young squirrels were 42 days old at this time and were still nursing.

It is interesting to compare the development of the first litter of young red squirrels which were born in a small cage while travelling with the second litter born in a much larger cage with little disturbance. One young of the first litter weighed 6 grams at birth while the four young of the second litter averaged 7.5 grams. The young of the first litter opened their eyes when 35 days old and weighed on an average approximately 23.7 grams while the second litter had their eyes open in 27 days and averaged practically twice as much in weight as the first litter did when their eyes opened. It seems evident that the unnaturally confined and disturbing conditions under which the first litter was raised were responsible for their retarded growth and the greater length of time which was necessary before their eyes opened. The development of the second litter is therefore to be taken as the more normal. RUTH DOWELL SVIHLA, *University of Michigan.*

A SILKY POCKET MOUSE IN CAPTIVITY

The U. S. Biological Survey office at Albuquerque, New Mexico, has been in possession of two silky pocket mice (*Perognathus flavus*) for five years and three and a half years, respectively. The older mouse, a female, called "Jeff" by the young ladies in the office, was captured south of Fort Fillmore, New Mexico, just west of the Santa Fe right-of-way, the latter part of January, 1923, and was adult when taken. She died December 20, 1928, at the Biological Survey office in Albuquerque. The name "Jeff" was given her because at the time of her capture the office was in possession of a cotton rat. The two were accordingly christened "Mutt" and "Jeff" by the girls.

The other mouse, also a female, was captured twelve miles north of Grant, New Mexico, about the middle of June, 1925. She was full-grown when taken and at present seems to be in a healthy condition.

Jeff proved herself to be a hardy mouse by the hardships she suffered and survived for five years. When caught she was retained in camp for about two weeks and then A. E. Gray brought her in his car to Albuquerque, New Mexico. She was confined in a baking-powder can while en route and had the misfortune to have her tail frozen, this necessitating its amputation. She survived this operation but the end of the stump never healed entirely. On many occasions she would be found fastened in her nest with the cotton stuck to her tail. Several times she was almost starved before being found and liberated.

About eight or ten months after being brought into the office, Jeff broke her right hind leg in the screen of the cage. Mr. Gray amputated the leg. She survived this operation and the stub of the leg healed over nicely. From this time on she was not quite so active but managed to eat and exercise sufficiently to live five years in captivity.

The cages in which the mice were kept are one foot square. Until October, 1928, they had only the wooden bottom of the cages on which to scratch. At that

time we added sand to the cages, which seemed to invigorate the mice as they spent much more time outside, digging and scratching in it.

Food: Rolled oats formed the chief food of the mice. One mouse would actually consume about one and a half level tablespoons of rolled oats every ten days. Maize was accepted when given, but it was not offered as a regular food. Lettuce, carrots, and apples were eaten in small quantities. These green foods were especially acceptable on Monday mornings. This was probably due to desire for moisture as they got no fresh food over week-ends. Water was kept in the cages almost continually but the mice were never observed drinking. The green food eaten probably supplied the moisture required.

Habits: When mouse number 2 was brought in, it was placed in the cage with mouse number 1. The surmise that they might enjoy each other's company was soon disproved. Fur flew in every direction and by the time they were separated both were covered with blood. It was decided that they had better live in single blessedness. Literature on this subject is not available in Albuquerque, so comparisons with natural habits can not be made. This behavior when they were placed together suggests that these mice probably live solitary existences, or in pairs, not colonies.

The presence of large quantities of food available at all times in the cages does not destroy their storing instinct. Each mouse is fed on an average one tablespoonful of rolled oats every other day. At each feeding all grain previously given is gone. When the nest, made of cotton placed in a box, is cleaned out about every ten days, the excess grain is found stored in several pockets in the cotton. The green foods have never been found stored in the cotton.

The mice were always more active at night, if a disordered cage was any indication. Each morning the desk on which the cages were kept was covered with sand indicating that much activity went on during the night.

It was interesting to note the activities of the mice when the sand was changed in the cages. They dug laboriously around the box containing their nest and did not cease until the box was partly buried in the sand.

Skull: Examination of the skull of the dead mouse under a microscope showed the molariform teeth to be loose and well worn. The lower teeth were worn smooth and concave. The incisors were also well worn. The skin and skull have been prepared and are in the collection in this office.

Acknowledgments: The following persons supplied data used in this paper and are responsible for making it possible: John Gatlin, who collected both specimens; A. E. Gray, who performed the amputations so successfully; and the girls in the office, who fed and cared for the pets.—SHALER E. ALDOUS, *U. S. Biological Survey, Albuquerque, New Mexico.*

A NEST OF PHENACOMYS SILVICOLA IN OREGON

On August 14, 1929, while strolling through the woods near the ocean beach at Netarts, Tillamook County, Oregon, at about 2:30 in the afternoon, my attention was attracted to an irregular mass of twigs about fifteen feet up in a fir tree that suggested the nest of a *Phenacomys longicaudus* as found in other parts of the state. My twelve-year-old son was soon induced to climb the tree while I stationed myself below to await developments. As the boy reached the nest and

started to work his fingers into the top, a dark-colored mouse leaped clear of the nest and tree to the ground, which at this place was covered with a dense mass of tall salal and dead brush. The mouse almost immediately disappeared. Much disappointed, Mrs. Jewett, our two children, and I searched the mass of brush and debris for a space of six or eight feet about the base of the tree, without results. We then sat down and kept perfectly quiet for perhaps an hour watching the tree and surroundings carefully in hope that the mouse might appear—still without results. I then climbed the tree to examine the nest, which satisfied me beyond all doubt that it truly was occupied by a *Phenacomys*. We then abandoned the locality.

Early the next morning, August 15, 1929, my son and I were again at the nest tree. The boy again climbed to the nest and worked his fingers slowly into the lower part of the structure and the mouse soon poked its head out of one of the nest entrances, but dodged back before it could be grasped in the boy's hand. However, it almost immediately reappeared at the other side of the nest from which it ran down the tree trunk headforemost. It was shot from the tree about six feet below the nest. In running down the tree it did not show much agility, but moved slowly and with caution as compared with the action of a squirrel or chipmunk.

The specimen proved to be an adult female *Phenacomys silvicola* that, on dissection, indicated that it had given birth to young in the not distant past. The measurements in millimeters, in the flesh, are as follows: Total length, 191; tail vertebræ, 86; hind foot, 23.

The measurements of the type specimen (No. 1214, Coll. S. G. Jewett) a young adult female taken on October 25, 1916, at Tillamook, Tillamook County, Oregon, by Alex Walker, are as follows: Total length, 191; tail vertebræ, 81; hind foot, 22.

The nest was placed against the body of a second growth Douglas Fir (*Pseudotsuga taxifolia*) standing in a grove of the same species, on a steep hillside. It was resting against the main trunk where a circlet of branches joined the tree fifteen feet above the ground. The skeleton of the nest was composed of dead dry twigs of fir; it was about fourteen inches in diameter and about ten inches deep, spherical in form with a flattened top, and well woven together and well anchored to the tree limbs on which it rested. The center of the nest was a well matted mass of dissected leaves of fir, the leftovers from past meals. Below the occupied part of the nest was a mass of decaying fir leaf fiber that, despite a long dry spell of weather, felt quite damp to the hand. Mixed with the leaf fiber were masses of the mouse feces in various stages of decay and mould. Two well defined galleries or tunnels traversed the nest leading to the outside. There was no indication of moss or other material in the nest structure other than the fir twigs and leaf fiber mentioned above. On top of the nest was found a number of freshly cut green fir twigs, apparently the food supply of the resident mouse.

The whole nest structure and its surroundings were found to be practically identical in every way with many nests of *Phenacomys longicaudus* examined by the writer in other parts of Oregon.

In the JOURNAL OF MAMMALOGY, vol. 2, p. 99, Mr. A. B. Howell, publishing his original description of this species, predicted that it would be found to be an arboreal species, basing his argument mainly on the hairiness of the tail of the type, which at that time was the only known specimen. The finding of this nest

proves that Mr. Howell's reasoning was correct.—Stanley G. Jewett, *Portland, Oregon.*

COLOR MUTANTS IN MICROTUS

Edward R. Warren has recorded the taking of an albino *Microtus nanus* in Colorado and has remarked on the rarity of this condition in the genus (Journ. Mamm., vol. 10, no. 1, p. 82, 1929). A mounted specimen of *M. p. pennsylvanicus* in the collection of the Royal Ontario Museum of Zoölogy (no. 29. 2. 21. 2) is white with the under-fur of a buff color. The color of the eyes in life is not known but the absence of coloring pigment in the covering hair of this individual suggests it to be strongly 'albinistic.'

A second specimen (R. O. M. Z. no. 27. 11. 28. 1), more recently acquired, is of a dark buff color, the under-fur, however, being gray. The eyes of this individual were apparently normally pigmented.

A third specimen (R. O. M. Z. no. 29. 4. 3. 1.) is a beautiful example of a "blonde" mouse. The dorsal region is very close to the "pinkish cinnamon" of Ridgway and the sides and ventral surface are gradually paled to "pale ochraceous-salmon." Although the color of the back is uniform to the base of the hairs, the under-fur of the sides and belly is darker than the surface, being like that of the back. The eyes of this specimen in the flesh were said to have been dark in color. L. L. Snyder, *Royal Ontario Museum of Zoölogy, Toronto, Ontario.*

A NOTE ON THE PIGMY VOLE IN COLORADO

The range in Colorado of the pigmy vole, *Lagurus pauperrimus* (Cooper), can be roughly characterized as the northwestern portion of the state, though actual records of its occurrence are rare. Its presence was first reported by Merritt Cary (Proc. Biol. Soc. Washington, vol. 20, pp. 23–28, 1907) who collected specimens at the following localities: west base of Medicine Bow Mountains, east of Walden, and Canadian Creek, Larimer County; and eight miles east of Lily, Routt (now Moffat) County. He also found a portion of a skull in the litter of a wood-rat nest at Douglas Spring, Moffat County. To these records E. R. Warren (Colorado College Publ., general ser. no. 33, engineering ser. vol. 1, no. 4, p. 76, 1908) added Hot Sulphur Springs, Grand County.

In 1924, while collecting in northwestern Colorado, the writer found a small colony of these mice near Two Bar Spring, twenty miles northwest of the junction of the Snake and Bear rivers, Moffat County. The area in general is a rolling sagebrush plain, though a considerable part is occupied by badland hills of shale, barren and deeply eroded, or by piñon and cedar clad sandstone ridges of slightly greater elevation. The altitude is approximately 6,000 feet; Upper Sonoran is the dominant zone, with a considerable admixture of Great Basin elements.

The location occupied by the mice was a sandy flat at the mouth of a dry gully issuing from the cedar hills. Sagebrush and greasewood scantily covered the flat, and the subsoil had been thoroughly riddled with the tunnels of foraging pocket gophers (*Thomomys ocius*), which were largely abandoned at the time and considerably broken. A series of ten specimens of the pigmy vole was obtained from May 11 to 21, all being trapped at holes entering the gopher tunnels where they passed under a clump of protecting vegetation. About many of these entrances were little piles of droppings or, less occasionally, tiny bundles of tender shoots

of greasewood cut in lengths of an inch or so. It was quite obvious that the tunnels were being used as runways and nest sites, the mice leaving them to search for food on the surface.

There are only three females in the series, two taken May 11 and 15 that were nursing, and one trapped May 21, containing six embryos. On May 15 was secured also a juvenile so small that he might well have been on his first venture away from the nest. All the males were in breeding condition.

These voles are at least partially diurnal and a number were seen at various hours of the day scurrying for shelter; some also found their way into my traps, and these were invariably destroyed by spermophiles (*Citellus t. parvus*). The voles shared their tunnel retreats, to a considerable extent, with the red desert pocket mouse (*Perognathus c. callistus*), and specimens of both species were taken at the same holes on different nights.—Frederic W. Miller, *Colorado Museum, Denver Colorado.*

PORCUPINE EATS WATER LILY PADS

On the shore of Little Square Pond in Franklin County, New York, on July 20, 1929, I noted a porcupine (*Erethizon dorsatum dorsatum*) eating the pads of the yellow water lily (*Nymphaea americana*). The creature, resting on the end of a log, reached one of the pads and sitting half-erect proceeded to eat it, even though I was in a boat not fifteen feet away.—W. J. Schoonmaker, *New York State Museum, Albany, New York.*

AN INTERESTING CAESAREAN OPERATION

I was interested in the article on "Breeding Habits of the Canadian Porcupine," by Parke H. Struthers, in the November, 1928, issue of the Journal of Mammalogy. Mr. Struthers's report on the young of the Canadian porcupine, at birth, differs slightly from my observations on the young of the yellow-haired porcupine (*Erethizon epixanthum*).

During the spring of 1927 I was a member of a field crew of the U. S. Biological Survey, operating on Anderson Mesa, near Flagstaff, Arizona. This area in the yellow-pine (*Pinus ponderosa*) belt at that time was heavily infested with the yellow-haired porcupine, and incidental to our prairie-dog control work we killed a number of these mammals.

Early one morning in the last week of May, four members of the crew, including myself, were poisoning over a number of small prairie-dog towns in a timbered area. Just as we had completed the first town I noticed a porcupine near the top of a small pine. I rode up to the tree and dismounted. Taking the long metal spoon that we used in handling the poisoned grain I climbed after the porcupine. The three other men rode up and sat in their saddles while I killed the porcupine by a sharp blow on the head with the edge of the spoon. I dislodged the dead animal from the tree and made my descent. As I stood near my horse, trying to remove the pine gum from my hands, the foreman of the crew asked me how to determine the sex of the dead mammal. The question was asked with sincerity, for most of the men on the crew were local cowboys; and a casual observer might easily be confused by the external genitalia of the porcupine. I explained as best I could, illustrating the points with the dead animal, but was not very convincing;

so to further prove my statement that the specimen was a female, I cut into the abdomen and removed the uterus and ovaries. The specimen was pregnant, with one well developed embryo in the right horn of the uterus. The sight of the swollen uterus led one of the men to inquire if porcupines were born with quills. I answered in the affirmative, but since my knowledge was not based on personal investigation I set to work with my pocket knife, removed the embryo from the uterus, and laid it upon the grass. It very much resembled a drowned kitten, for the dark hair was plastered tightly to the body and no quills were apparent. While I crouched beside the carcass and talked with the men who had remained in the saddles, I unconsciously played with the fore foot of the embryo. The astonished expression on one man's face caused me to glance downward, and I was much surprised to see the young porcupine gasp. For the next few minutes I worked over the little chap feverishly, and was rewarded by bringing him to life. By this time the other men had climbed out of their saddles and grouped around. We tied and cut the umbilical cord, dried him with a piece of cloth, and placed him in the sun.

He made repeated efforts to use his legs, and at the end of fifteen minutes, was able to waddle for a few feet. By this time the action of the sun had dried him into a dull-black, fuzzy ball. Underneath this scanty hair we observed short, slender quills still in a soft state. One of the first actions that we noted was the characteristic, defensive, flip of the tail. He attempted to 'turn tail' toward any offending hand.

As our routine work could not be delayed any longer, I bundled the little fellow up in my handkerchief—approved 'stork' fashion—and suspended it by a cord around my neck so that the little chap rested against my chest. In this fashion he spent the following three hours on horseback, while I distributed poisoned grain for the control of prairie-dogs. During this ride I noted, for the second time, the presence of the tiny quills; for as the hot sun dried them they began to pierce through the handkerchief and my thin cotton shirt. The quills, of course, were very short and slender and I suffered no discomfort from them other than being aware of their presence. Back in camp at the noon hour I carefully removed the handkerchief, without removing too many of the quills, and deposited our new mascot in an empty packing case.

The little chap proved to be a very interesting but exacting pet. It was surprising how quickly he could assume a defensive position. When anyone approached his box he would lower his head, erect his quills, and give a few flips of his tail in the manner of a warning. If you were alert you could make several stroking motions from the little fellows head, and as a general rule he would lay down the quills and cautiously explore the proffered hand for food. When not frightened he would play much like a kitten. He became very tame and would submit to handling and petting. I held him on my knee while feeding him condensed milk with a spoon. The young porcupine required so much attention at the busy field camp that we were forced to include him after ten days' time, among our collection of skins.

The same week of 'Porky's' exodus, one of the men killed an adult female porcupine within 200 yards of camp. When I examined the animal I found the right horn of the uterus much enlarged but empty, which led me to believe that she had but recently given birth. After a few minutes search we found a very

alert young porcupine under a log not thirty feet from the tree in which the female had been feeding. The young porcupine was evidently but a day old. We caught the third day-old porcupine that same week.—DONALD A. SPENCER, *U. S. Biological Survey, San Antonio, Texas.*

A WOOLLY WHITE-TAILED DEER

On December 2, 1928, while making a field study of white-tailed deer shot by hunters in Union and Snyder counties, Pennsylvania, during the 1928 Special Season on antlerless deer, I examined briefly at one of the camps in Union County not far from the Cherry Run station, a large female animal whose back, sides and shoulders were covered with soft thick woolly hair, which was noticeably

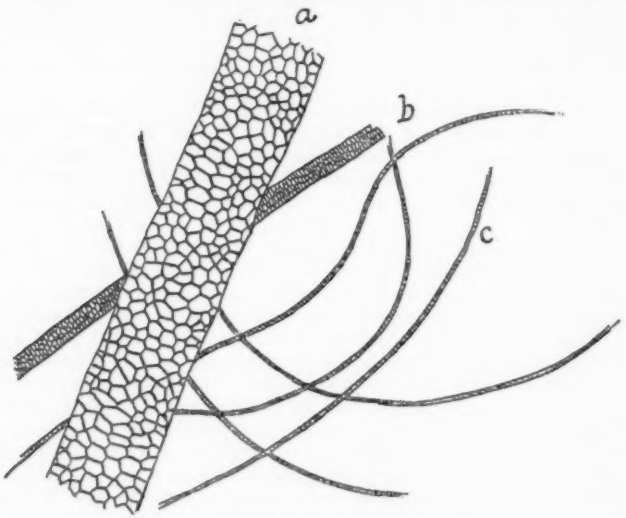


FIG. 1. HAIR OF WHITE-TAILED DEER. 8×

a, normal heavy hair; *b*, normal fine hair; *c*, silken hair from back and shoulder region.

different from the normal coarse firm straight hair that covered the rest of the body. This wool (for the hair certainly had the appearance of very fine wool) was silken and soft to the touch; the individual strands were very slender and *wavy;* its color was pale gray-brown, a little lighter in shade than the normal hair of the rump, and it was altogether without any tendency toward grayish or whitish tipping such as normal hair from the back showed.

It has been suggested that this type of hair sometimes results from an injury sustained by the animal in early life. The considerable area covered by this wool, which even at a distance appeared rough and rather shaggy, seems to me to indicate that local wounds could hardly have had much to do with the matter.

A skin disease, or some sort of infestation of mites, fleas, or ticks might have induced the condition. If the uncomfortable animal had scraped its skin savagely in trying to relieve the itching or to eliminate the pests, extensive sores might have developed which eventually would so have affected the hair cells as to produce an actual change in the type of hair. While I did not preserve a specimen of the skin, I noted that it appeared to be perfectly normal in color and general appearance, and the animal seemed to be normal in other respects. Its teats were somewhat swollen as though fawns had recently been nursing.

In the accompanying diagram the size and structure of the fine wavy hair, as seen when magnified about eight times, may be compared directly with that of the normal coarse straight hair.—GEORGE MIKSCH SUTTON, *Game Commission, Harrisburg, Pennsylvania.*

SIX UTAH MAMMAL RECORDS

Citellus spilosoma cryptospilotus. Two specimens were obtained in San Juan County. Both were females. The first was presented to me in the flesh by S. E. Piper, May 11, 1928, and was obtained about one and one half miles northeast of Lockerby, Utah. Measurements were: Total length, 168 mm.; tail, 27; hind foot, 29. A portion of the tail was missing. About half the stomach contents consisted of poisoned oats, a third oil-beetles, and a sixth green grass. Indications of pregnancy were present.

The second specimen was obtained about 4 miles east of Monticello, Utah, at an elevation of about 7,000 feet, May 19, 1928. Measurements were: Total length, 211; tail, 64; hind foot, 29. Seven fetuses were present, with an average dilation of 12 mm. Stomach contents consisted entirely of fresh alfalfa leaves, which had been poisoned.

Choice of habitat appeared to be in the lighter soils, where burrows with several entrances were usually found under some low shrub, preferably a grease wood. This species has been observed by the writer in Carbon and Grand Counties.

Perognathus apache caryi. One specimen, a male, was obtained, May 20, 1928, at Hatch Crossing, about 30 miles north of Monticello, Utah. Measurements were: Total length, 144; tail, 74; hind foot, 19. Stomach contents consisted entirely of poisoned oats. The location was quite sandy, and dead tumble-weed afforded excellent cover.

Ochotona princeps nevadensis. One adult female, one immature, and the skull of a badly decomposed specimen were obtained on July 18, 1928, in a limestone rock-slide about a mile northeast of the Baldy Ranger Station on the Manti National Forest. The station is 17 miles east and 2 miles south of Gunnison, Utah. The elevation at which they were taken is about 10,000 feet.

Their occurrence was noted during the summer of 1927 by their alarm call, resembling a brief "twang," much the same as that of a spent bullet. This year, however, this warning call was not heard although the time of day was the same and the days bright in both instances. Not until their haystacks, consisting entirely of blue-bells (*Mertensia ciliata*), were seen, was their presence indicated, and soon after a few scattered alarm cries were heard.

The pika colonies in this locality are apparently upon the decline. Three large

slides are in the vicinity, the smallest more than a mile in length. All show by old sign a heavy population at one time. One slide is now entirely dead, while the other two contain very few compared with the past.

This subspecies, formerly known only by three specimens from the Ruby Mountains in northeastern central Nevada, jumps an intervening semi-desert country, and is again found in the Wasatch Mountains, about 250 miles southeast of the type locality.

Dipodomys ordii luteolus. This kangaroo rat is common in the vicinity of Vernal, Utah. The first specimen obtained on May 20, 1927, a female, measures: Total length, 259; tail, 145; and hind foot, 41.

Dipidomys microps celsus. Two specimens were obtained near Washington, Utah, March 3, 1928. Measurements of a male were: Total length, 296; tail, 174; hind foot, 45. The measurements of a female were: Total length, 281; tail, 166; hind foot, 42. The female carried three fetuses.

Dipodomys merriami merriami. Two specimens, both males, were obtained March 3, 1928, near Washington, Utah, and in the same field as the *Dipodomys* just mentioned. Respective measurements were: Total length, 240, and 252; tail, 142 and 142; hind foot, 39 and 40. The typical mound was present with its numerous entrances, a mound that has not been observed with any of the other Utah species of *Dipodomys*. This is the first record of this species north of the Colorado River.—A. W. Moore, *Biological Survey, Portland, Oregon.*

RECENT LITERATURE

Clark, James L. Trails of the Hunted. Boston: Little, Brown and Company. 8vo, pp. xiii 309, 47 illus. Cloth $4. 1928.

In this book James L. Clark summarizes some experiences of twenty-five years in hunting, studying, and mounting many of the larger game animals of North America, Africa, and Central Asia. As the pages turn the impression grows that the book is a record of outstanding achievement, set down with the same regard for truth that characterized the modeling of his splendid mounted groups. Thrilling adventures with potentially dangerous animals are numerous, but they are related in a manner convincing one that they record only the real behavior of wild animals. Of the five potentially dangerous animals in Africa, the lion, leopard, buffalo, elephant, and rhino, he cites the buffalo as the one most to be feared, and regards this as the consensus of opinion among experienced hunters.

Clark's work in Africa began in 1909, when he became the protector for the wild life photographer, A. Radclyffe Dungmore. His duty was to stand by with rifle ready, while Dugmore with his face buried in the hood of a huge reflex camera attempted close-ups of animals, some of which resented the impertinence. He outstayed Dugmore, remaining in Africa fourteen months. Since then he has periodically gone into the field. He has hunted and studied animals in Nova Scotia, Wyoming, Alberta, British Columbia, and Alaska. Three trips were made

to Africa where he was associated in the field with Carl Akeley. And with William J. Morden he has crossed Asia, from India and the borders of Afghanistan, to Siberia and China.

The narrative is replete with first hand observations of life habits, upon which are based generalizations concerning the game animals of three continents. And with the sympathetic understanding apt to come, especially through first hand knowledge of the lives of animals, the author deplores the rapid depletion of the game fields. Between his two visits to the Athi Plains, in Africa, in 1909 and 1923, vast changes took place. In 1909 "huge herds of zebras, hartebeests, impallas, giraffes, and scores of other harmless creatures, together with occasional rhinos and lions and other animals, all could be found on those wonderful grassy plains. Today one may travel for days at a time in that same district and see only a fraction of the numbers that once covered the plains as far as the eye could reach."

In 1923, as a member of the first American party, he visited the little known great Crater of Ngorongoro, in Tanganyika Territory. The description of that extraordinary place seems worth quoting at length. He says: "Imagine yourself standing on the edge of a gigantic bowl twelve miles in diameter, with huge sweeping walls rising to a wonderfully uniform height two thousand feet above the level of the bottom. Imagine stepping suddenly to such a place, and holding tensely to the slender branches of the bushes while you gazed down upon lakes and forests and plains that were so merged into uniformity by the distance as to seem like nothing more than a gigantic and amazingly smooth floor covered with a patchwork of different shades of green and tan, with here and there the sheen of sunlight on smooth water. . . . .

On the crater floor were enormous herds of zebras and wildebeests, while elephants, buffaloes, hippopotami, rhinos, monkeys, lions, and cheetahs were found in lesser abundance. Of all the places in the world the author regards the Crater of Ngorongoro as the most perfect for an animal refuge, and feels that it would be desirable to try to get the British Government to set it aside for this purpose.

A chapter is devoted to American game and discussion of various species leads up to the statement: "But of all the game in all the world, mountain sheep and mountain goats are the prize trophies."

Dealing at length with the animals of Africa, but not wishing to leave the human natives entirely out of the picture the author has a chapter on African natives and safaris. The tribesmen of British East Africa receive the same sympathetic treatment as the animals. There is generous appraisal both of their childish irresponsibility, and of their bravery and skill.

September, 1926, found Clark and William J. Morden at Karashar, Chinese Turkestan. They had crossed the Himalayas from India and had hunted *Ovis poli* in the Russian Pamirs, where more than sixteen hundred of these reputedly rare sheep were seen in a month. From Karashar they started on a march of 2,000 miles, much of it to be by camel caravan through the Gobi Desert, Mongolia. En route they were captured and tortured by Mongols, and taken as prisoners to Kobdo where through Russian assistance they were liberated but forced to proceed north to the Trans-Siberian Railroad. To attempt such a journey, so late in the season, and under other conditions so unpromising was probably imprudent, out it is through such imprudence that worth while goals are often reached, and all's well that ends well.

The book will have a permanent value, embracing as it does not only unusual personal experiences, but comment on conditions touching the status of most of the larger wild animals of the world, and the matured conclusions of a man who in the contemplation of nature has had opportunity for clear reflection. In summing up his work he says: ". . . . If I have been able to help in the important task of presenting to the public a truthful picture of animals, I have not failed at what I set out to do."—E. A. GOLDMAN, *U. S. Biological Survey.*

Bryant, Harold Child. OUTDOOR HERITAGE. San Francisco, Los Angeles, Chicago: Powell Publishing Co. 8vo, pp. [6], 465; 14 illus., Cloth, 1929. (One of a series of nine volumes on California.)

To review adequately this notable book would involve writing another. We must therefore be content to urge everyone who is interested in any phase of outdoor life, and in its preservation, to read this volume. It reflects mainly conditions in California, the author's native state, and the one in which most of his 35 years of active nature study have been spent. But his conclusions are broad, and with reason may be applied to most other sections of our land, and to many a one beyond our boundaries.

More than any other points, perhaps, the author stresses the benefits, spiritual and mental, that come unbidden to any one really interested in outdoor study, and the vital need to preserve the raw material that alone makes available these priceless resources.

Among the eleven chapters are those entitled: Mammal Memories; Trees; Finny Favorites; Marks for the Gunner; The People's Playgrounds; The Four Horsemen.

'Mammal Memories' is the story of California's extinct species, mainly those whose passing has come about by the orderly way of Nature's processes, but touching also on those whose existence has been terminated by man. "During our lifetime we are actually witnessing the closing of the age of mammals. When nature plays a sole hand we may be content, but when the end is hastened by man's spoliation we may well worry about the results of our short-sightedness and wasteful methods. A study such as this should lead everyone to join the army of defense and constitute himself a conservationist."

'Marks for the Gunner' treats of the larger game animals (most of which, excepting the deer, have practically vanished), with their natural enemies, the smaller game animals, the fur-bearers, and the various groups of game birds. For some of these groups the author holds out little hope.

'The Four Horsemen'—War, Famine, Pestilence, and Death—are the enemies of wild life. Chief of the instruments of War are the gun and trap and poison. "So long as the casualty list is not too great, war continues without imperiling either side, but when the total becomes too great, danger is imminent. Whether our resources in wild life can withstand such a drain seems doubtful." Famine and Pestilence have taken, and are still taking, vast toll. "Death: extinction—is most to be feared. The grim reaper has met but little opposition. . . . . All of the larger game animals with the exception of the deer have been placed on the shelf, so to speak, for safe-keeping. Elk, antelope, and mountain sheep are given protection the year around. Many fur-bearing animals, including the wolverine, fisher, and beaver, are in imminent danger of extermination. Likewise, there is a long list of game birds that are given total protection and many others that

show great reduction in numbers. Only one non-game bird, the condor, belongs to the list of disappearing species."

The book is not all discouragement, but the warnings constitute, perhaps, its most valuable feature. Such warnings are not merely pessimism; they are the symptoms that point out where lies the disease. To ignore symptoms is unwise.

"What'er the gifts o' gods to men,
What'er the blessings men enjoy,
The gods ne'er give those gifts again,
Nor re-create what men destroy."

—E. A. PREBLE.

Miller, Gerrit S., Jr. THE CONTROVERSY OVER HUMAN "MISSING LINKS." Smithsonian Report for 1928, pp. 413–465, pls. 5. November, 1929.

Ever since Darwin definitely put forth the view that the existing forms of life were derived from others more remote in time, through the process of gradual change from more lowly to more specialized forms, popular imagination has pictured the 'missing link' that would afford the intermediate step from the manlike ape to the apelike man or to modern man himself, not realizing that such a step may have been so gradual that in reality many such "links" may be sought for, showing various combinations of human and simian traits. That palaeontological evidence for such steps has been so slow in forthcoming has proved for some an objection to the theory itself. Yet when one considers not only the relative rarity of the conditions requisite for the preservation of such relics but also the extraordinary chance that these should ever be discovered at all, he becomes less expectant. The general tendency has been to regard such stages as having lived in the relatively not-distant past, as in the Pleistocene period particularly. But Osborn and Matthew have shown that this period was in general a time of many extinctions rather than one favorable for progressive evolution so that we should probably look for the remains of a pre-human stock in much earlier deposits, Pliocene or even Miocene.

The paper here reviewed is really less a discussion of these earlier stages of man's history than a most equable presentation of published opinions on the precise nature of but two 'finds,' the Trinil man of Java, *Pithecanthropus erectus*, and the more recently discovered Piltdown man of England, *Eoanthropus dawsoni*. On the latter the author had already published the opinion that the fragment of a lower jaw associated with the other cranial bits was in reality that of an anthropoid closely allied to the existing chimpanzee. These two finds are now both regarded as of Pleistocene age, though the former is sometimes referred to Pliocene. Although no final conclusions are presented, it is clear that the known fragments by which these two ancient types of men are represented are so few and so imperfect that they form no adequate basis for an exact reconstruction or for a comparison with either living men or anthropoids. As the author himself puts it, "we should not hesitate to confess that in place of demonstrable links between man and other mammals we now possess nothing more than some fossils so fragmentary that they are susceptible of being interpreted either as such links or as something else," which does not in any way invalidate the general conclusion of the evolution of man from some anthropoid ancestral group.—GLOVER M. ALLEN.

Broom, Dr. R. NOTE ON THE MILK DENTITION OF AUSTRALOPITHECUS. Proc. Zool. Soc. London, 1929, pp. 85–88, figs. 1–5.

Lankester, 1915: "The Piltdown jaw [*Eoanthropus*] is the most startling and significant fossil bone that has ever been brought to light."

Broom, 1929: "Holding as I do that it [the Taungs skull, *Australopithecus*] is by far the most important fossil ever discovered. . . ."

These two quotations clearly show the influence of that emotional stress under which so much of the literature dealing with man's ancestry has been written. I have already pointed out the curious manner in which the accepted principles of paleontological reasoning tend to be departed from in discussions of the Piltdown fossils (Amer. Journ. Phys. Anthrop., vol. 1, pp. 27–28, 1918). Dr. Broom's note is interesting in the same connection. It is limited to a consideration of the outer aspect of the teeth; and because *in this one feature* he finds some points of greater resemblance to the milk dentition of an American Indian child than to the milk teeth of one gorilla and two chimpanzees the author does not hesitate to conclude "that it [*Australopithecus*] is an Anthropoid Ape very much nearer to the form which gave rise to Man than either the Chimpanzee or the Gorilla. . . . And as it was, we have good reason to believe, from a cliff and plains-loving pro-Gorilla that mankind arose, I think there is much to be said in favor of *Australopithecus* being very near to the origin of the human stem, and possibly even being the very ancestor."

The evidence presented by Dr. Broom rather strongly supports the opinion that *Australopithecus* is a valid anthropoid genus; but, were he reasoning normally and without the emotion that is commonly aroused by this subject, neither he nor anyone else trained in systematic zoology could fail to realize that the exact position of this genus with regard to man and the great apes could only be determined by study of the combined characters of the feet, the adult skull and the crowns of the adult teeth. All of these are now unknown.—G. S. MILLER.

ADAMS, DONALD KEITH. Experimental studies of adaptive behavior in cats. Comp. Psych. Monographs, vol 6, no. 1, pp. 1–168, illus. Baltimore: The Johns Hopkins Press. Paper, $2.50. May, 1929. (A detailed study based upon puzzle-box and vertical-string experiments).

ALTOBELLO, G. Un Nuovo genere della Famiglia *Soricidae*. Rev. Franç Mamm. vol. 1, pp. 6–9, fig. 1, December 7, 1927.
(*Soricidus monsvairani* gen, et sp. nov. from Italy).

ANDERSON, CHARLES. Palaeontological Notes No. 1. Macropus titan and Thylacoleo carnifex Owen. Records Australian Mus., Sydney, vol. 17, no. 1, pp. 35–49, pls. 17–23. June 20, 1929.

ANDERSON, R. M. The water shrew (Sorex palustris) in Ontario. Canadian Field Nat., vol. 43, pp. 136–137. September 3, 1929.

BARANOFF, N., AND J. JEŽIĆ. Fliegenmaden als Wundschmarotzer bei den Haustieren in Südserbien. Zeitschr. f. Parasitenkunde, vol. 1, pp. 416–422, 4 figs. Oct. 27, 1928.

BARTLETT, ILO, H., AND JOSEPH H. STEPHENSON. A preliminary survey of deeryards in the upper peninsula of Michigan. Papers Mich. Acad. Sci. Arts & Lettr., vol. 10, pp. 411–416, pl. 1, 1929.

BARTLETT, ROBERT A. The sealing saga of Newfoundland. Nat. Geogr. Mag., vol. 56, no. 1, pp. 91–130, illus. July, 1929. (Methods of hunting seals.)

BRYANT, H. C. Marmots are disappearing. Yosemite Nature Notes, vol. 8, p. 94. October, 1929.

——— Mountain sheep skull found on Parson's Peak. Yosemite Nature Notes, vol. 8, p. 100. October, 1929.

CABRERA, ÁNGEL. Sobre La Estructura de la Mano y del Pie en el Megaterio. Anales Soc. Cien. Argentina, vol. 107, pp. 425–443, 1929.

CASTLE, W. E. The rex rabbit. Journ. Heredity, vol. 20, pp. 193–199, fig. 4. May, 1929.

CHLOPKOW, A. Einige neue Daten zur Frage von der Struktur der Schlussleisten and Becherzellen des Darmepithels bei Säugetieren. Zeitschr. Zellforschung u. Mikroskopische Anatomie, vol. 7, pp. 502–512. 15 figs. Aug. 23, 1928.

COLTON, H. S. "High Brow" albino rats. Journ. Heredity, vol. 20, pp. 225–227, 2 figs. May, 1929.

COOPER, C. FORSTER. On the ear region of certain of the *Chrysochloridae*. Philos. Trans. Roy. Soc. London, (B), vol. 216, pp. 265–283, pls. 15–17, figs. 4, March 21, 1928.

COVILLE, L. Squirrel or peach-pit—"Who's the Nut?" Journ. Heredity, vol. 20, p. 387, 1 fig. August, 1929. (Peach-pits gnawed on both sides by squirrels although first opening is sufficient for obtaining the kernel.)

[DE LESTANG, ALBERT]. A bat colony. Australian Zool., vol. 6, Pt. 1, pp. 106–107, August 13, 1929.

DIETRICH, W. O. Ueber einen Schädel von *Ictitherium* (Fam. *Viverridae*). Neues Jahrbuch Mineral., Geol. u. Pälaont., Abt. B, vol. 57, pp. 364–371, pl. 1, fig. 1, 1927.

DOLLMAN, J. GUY. A South African giraffe. Nat. Hist. Mag., London, vol. 2, No. 10, pp. 64–67, fig. 1, April 1929.

DYMOND, J. R. Some little brown bats from Ontario. Canadian Field-Nat., vol. 43, p. 137. September 3, 1929.

EHIK, DR. J. Der Steppeniltis (*Mustela Eversmanni* Less.) in Ungarn. Ann. Mus. Nat. Hungarici, vol. 25, pp. 1–37, figs. 1–6, 1928. (New: *Mustela eversmanni soergeli; Mustela eversmanni hungarica.*)

FIELDS, P. E. The white rat's use of visual stimuli in the discrimination of geometrical figures. Journ. Comp. Psych., vol. 9, pp. 107–122. February, 1929.

FRY, T. B. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. Report No. 46. On a collection from Toungoo, Burma. Journ. Bom. Nat. Hist. Soc., vol. 32, No. 3, pp. 545–547, January 15, 1928. (Lists 18 forms.)

GABLE, CHARLES H. Bats as a Solution of Insect Problems. Better Fruit, vol. 23, No. 4, pp. 5–7, 2 figs., October 1928. (Texas bat roosts.)

GENGERELLI, J. A. The effect of rotating the maze on the performance of the hooded rat. Journ. Comp. Psych., vol. 8, pp. 377–384, 3 figs. December, 1928.

——— Preliminary experiments on the causal factors in animal learning. Journ. Comp. Psych., vol. 8, pp. 435–457, 3 fig. December, 1928.

——— Preliminary experiments on the causal factors in animal learning. II. Journ. Comp. Psych., vol. 9, pp. 245–274, 15 figs. August, 1929.

GOULDSBURY, C. P. The Big Bull of Sembutollavu. Journ. Bombay Nat. Hist. Soc., vol. 32, No. 4, pp. 678–682, May 31, 1928.

GRAY, ROBERT W. Mammalian Life in High Latitudes. Nature, London, vol. 124, No. 3119, p. 228, August 10, 1929. (Notes on seals and whales.)

HADWEN, SEYMOUR. Color changes in Lepus americanus and other mammals. Canadian Jour. Research, Ottawa, vol. 1, no. 2, pp. 189–200, pls. 4–8. July, 1929.

HEGNER, R., AND E. SCHUMAKER. Some intestinal amoebae and flagellates from the chimpanzee, three-toed sloth, sheep and guinea-pig. Journ. Parasitology, vol. 15, pp. 31–37, 1 fig. September, 1928.

HELBING, H. Zur Carnivorenfauna süddeutscher Miocänfundorte. Actes Soc. Helvétique Sci. Nat., No. 109, pt. 2, pp. 221–222, 1928.

HINTON, MARTIN A. C. A desman from Portugal. Nat. Hist. Mag., London, vol. 2, No. 10, pp. 49–50, fig. 1, 1929.

HOPWOOD, A. TINDELL. *Hylochoerus grabhami*, a new Species of Fossil Pig from the White Nile. Ann. & Mag. Nat. Hist., Ser. 10, vol. 4, pp. 289–290, September 1929.

——— New and little-known mammals from the miocene of Africa. Amer. Mus. Novitates, No. 344, pp. 1–9, figs. 6, March 9, 1929. (New: *Austrolagomys simpsoni; Apodecter; Apodecter stromeri; Phthinylla; P. fracta; Myohyrax osborni*.)

HORNADAY, W. T. Crowd the "vermin" and blame everything but guns! Parks and Recreation, vol. 12, pp. 316–317. August, 1929.

HUGUES, ALBERT. Le Vespertilion de Natterer *Myotis Nattereri* (Kuhl), dans le Gard. Rev. Franç Mamm., vol. 1, No. 1, pp. 42–43, December 7, 1927.

——— Le campagnol souterrain *Pitymys subterraneus* Sélys, en Normandie. Rev. Franç Mamm., vol. 1, No. 1, pp. 40–41, December 7, 1927.

IRWIN, M. R. The inheritance of resistance to the Danysz bacillus in the rat. Genetics, vol. 14, pp. 337–365, 4 figs. July, 1929.

ISACHSEN, GUNNAR. Modern Norwegian whaling in the Antarctic. Geogr. Rev., New York, vol. 19, No. 3, pp. 387–403, 1 map, pls, 3, figs. 21, July, 1929.

KADANOFF, D. Über die intraepithelialen Nerven und ihre Endigungen beim Menschen und bei den Säugetieren. Zeitschr. f. Zellforschung u. Mikroskopische Anatomie, vol. 7, pp. 553–576, 18 figs. Aug. 23, 1928.

KLOSS, C. BODEN. Some remarks on the gibbons, with the description of a new subspecies. Proc. Zool. Soc. London, 1929, pt. 1, pp. 113–127, April, 1929. (New: *Hylobates cinereus abbotti*.)

——— The Arctictis of Java. Treubia, Buitenzorg, vol. 10, p. 497, June 1929. (Selects Java as the type locality of *Arctictis binturong albifrons*.)

KNOTH, MAX. Neue-Versuche zur Züchtung der in Pansen von Wiederkäuern lebenden Ophioscoleciden (Ciliata). Zeitschr. f. Parasitenkunde, vol. 1, pp. 262–282. Aug. 10, 1928.

KOLLER, OTTO. Über das Vorkommen des Tigeriltis (*Putorius sarmaticus*) bei Marburg (S. H. S.). Zool. Anzeiger, vol. 83, p. 70, 1929.

——— Das Vorkommen von *Rupicapra rupicapra* auf dem Berge Olymp (Griechenland). Zool. Anzeiger, vol. 83, p. 46, June 15, 1929. (New: *Rupicapra rupicapra olympica*.)

KRAGLIEVICH, LUCAS. Descripción le los astrágalos de dos gravigrados terciarios de la subfamilia Nothrotherinae. An. Soc. Cien. Argentina, vol. 106, No. 6, pp. 332–342, figs. 3, 1928. (New: *Pronothrotherium parvulum* and *Senetia mirabilis*.)

KRIEG, HANS. Über südamerikanische Haustiere I. Zool. Garten, N. F., vol. 1, pp. 273–284, pls. 1–7, 1929.

——— Biologische Reisestudien in Südamerika. IX. Gürteltiere. Zeitschr. Morph. und Ökol. der Tiere, vol. 14, pp. 166–190, figs. 1–15, March 12, 1929.

KRÜGER, V. F., AND H. SCHUHKNECHT. Über die Katalytische Wirkung des Blutes verschiedener Wirbel-Tiere. Zeitsch. f. Vergleichende Physiologie, vol. 8, pp. 635–657, 1 fig. Dec. 4, 1928.

LASHLEY, K. S. AND J. BALL. Spinal conduction and kinesthetic sensitivity in the maze habit. Journ. Comp. Psych., vol. 9, pp. 71–105, 1 fig., 2 pls. Feb. 1929. (White rats.)

LAVAUDEN, L. Contribution à l'Histoire naturelle des Buffles. Rev. Franç Mamm., vol. 1, pp. 10–39, pls. 1–5, December 7, 1927.

——— Notes de mammalogie nord-africaine. Les Chats. Bull. Soc. d'Hist. de l'Afrique du Nord, vol. 19, pp. 255–262, July 1928.

LEUBA, J. H. AND V. FAIN. Note on orientation in the white rat. Journ. Comp. Psych., vol. 9, pp. 239–244, 1 fig. June, 1929.

LINDSAY, HELEN, M. Scientific Results from the Mammal Survey. No. 49. A New Flying Squirrel from Nepal. Journ. Bombay Nat. Hist. Soc., vol. 33, No. 3, pp. 565–569, May 31, 1929. (New: *Sciuropterus gorkhali*.)

LÖNNBERG, EINAR. A Hybrid between Grey Seal, *Halichoerus grypus* Nils. and Baltic Ringed Seal, *Phoca hispida annellata* Nils. Arkiv för Zoologi, Vol. 21 A., No. 5, pp. 1–8, figs. 1–9, July 22, 1929.

LOOMIS, F. B. Phylogeny of the deer. Amer. Journ. Sci., vol. 16, No. 96, pp. 531–542, figs. 10, 1928.

LORD, ELIZABETH M., AND WILLIAM H. GATES. Shaker, a new mutation of the the house mouse (Mus musculus). Amer. Nat., vol. 63, pp. 435–442. September, 1929.

(A behavioristic mutation of the house mouse that expresses itself in the form of nervous head-movements, circling and deafness. It behaves in inheritance as a single gene character, recessive to the normal, and not sex-linked.)

LOUTTIT, C. M. Reproductive behavior of the guinea pig. II. The ontogenesis of the reproductive behavior pattern. Journ. Comp. Psych., vol. 9, pp. 293–304, 1 fig. August, 1929.

LULL, R. S. Remarkable Ground Sloth. Bull. Geol. Soc. Amer., vol. 40, No. 1, pp. 246–247, March, 1929.

MATHIS, JÜRG. Vom Leben der gemeinen Fledermaus. Zeitschr. Morph. und Ökol. der Tiere, vol. 13, pp. 706–721, fig. February 25, 1929.

MATSCHIE, P. AND L. ZUKOWSKY. Die als *Sigmoceros* bezeichnete Gruppe der Kuhantilopen. III. Die in Deutsch-Ostafrika mit Ausnahme des Sudwestens vorkommenden Arten. Sitz. Ber. Gesell. Naturf. Freunde, Berlin, for 1922, pp. 79–142, pls. 5–7, April 30, 1925. (New: *Sigmoceros gudowiusi; S. dieseneri; S. wintgensi; S. prittwitzi; S. schmitti; S. ulangae; S. lacrymalis; S. schusteri; S. saadanicus; S. gendagendae; S. janenschi; S. tendagurucus; S. hennigi; S. lindicus; S. grotei; S. rowumae; S. rendalli; S. ungonicus; S. ungoniensis*.)

MATSUMOTO, H. On *Leith-Adamsia siwalikiensis*, a New Generic and Specific Name of Archetypal Elephants. Inst. Geol. & Palaeont. Tohoku Imp. Univ., Sendai., p. 213. (Manuscript received October 14, 1927.)

MATTHEW, W. D. Critical observations upon Siwalik Mammals. (Exclusive of *Proboscidea*). Bull. Amer. Mus. Nat. Hist., vol. 56, pp. 437–560, figs. 1–55, February 9, 1929. (New: *Hyaena* (*Hyaenictis*) *bosei*.)

——— Reclassification of the Artiodactyl families. Bull. Geol. Soc. Amer., vol. 40, No. 2, pp. 403–408, June 1929.

MATTHEW, W. D., W. GRANGER, AND G. G. SIMPSON. Paleocene Multituberculates from Mongolia. Amer. Mus. Novitates, No. 331, pp. 1–4, October 30, 1928. (New: *Sphenopsalis nobilis*, gen. et sp. nov.)

MCCRACKEN, HAROLD. On the icy trail of aivik. Sportsman, vol. 6, pp. 64–66; 68–69, illus. August, 1929. (Brief account of an expedition after specimens of the walrus for the American Museum of Natural History.)

MELANDER, W. A. Eine rot-gelbe Abart des Iltis (*Putorius putorius* Linn) in dem gouvernement Smolensk. Wissensch. Mitteil. Univ. Smolensk., vol. 3, pp. 135–143, 1926. [Russian text with German summary.] (New: *Putorius putorius* var. *stantschinskii*.)

MELTZER, H. Vergleichende Untersuchungen über die Härte der Skelettmuskeln beim Warm—und Kaltblüter, nach dem Tode and während der Totenstarre. Zeitschr. f. Vergleichende Physiologie, vol. 8, pp. 78–88. Aug. 25, 1928.

MENNER, E. Untersuchungen über die Retina mit besonderer Berücksichtigung der äussern Kornerschicht. Ein Beitrag zur Duplizitätstheorie. Zeitschr. f. Vergleichende Physiologie, vol. 8, pp. 761–826, 59 figs. Jan. 19, 1929. (Much on mammals.)

MILLER, GERRIT S., JR. The Pollack Whale in the Gulf of Campeche. Proc. Biol. Soc. Wash., vol. 41, p. 171, October 15, 1928.

——— The Generic Position of the Porpoise described by Philippi as Tursio? Panope. Proc. Biol. Soc. Wash., vol. 41, p. 171, October 15, 1928. (A member of the genus *Cephalorhynchus*.)

MONTANDON, GEORGE. Un Singe d'Apparence Anthropoide en Amerique du Sud. La Nature, pp. 439–440, May 15, 1929. (Describes new family, *Ameranthropoidae*; new genus, *Ameranthropoides*, and new species, *A. loysi*.)

MORI, T. On the Corean Bats. The Zool. Soc. of Japan, Tokyo, pp. 284–303, pl. 3, 1928. (Text in Japanese). (New: *Myotis chofukusei; Eptesicus brachy digitus; Eptesicus kobayashii; Vespertilio aurijunctus*.)

NELSON, E. W., AND E. A. GOLDMAN. A new antelope squirrel from Lower California. Journ. Wash. Acad. Sci., vol. 19, No. 13, pp. 281–282, July 19, 1929. (New: *Ammospermophilus leucurus extimus*.)

NEUVILLE, H. De certains caractères de la forme humaine et leurs causes. L'Anthropologie, Paris, vol. 37, pp. 305–328; 491–515, figs. 15, 1927.

NEWCOMBE, W. A. The sea-otter (*Enhydra lutris lutris* Linn.). Rep. Prov. Mus. Nat. Hist., [Victoria], 1928, pp. f12–f14, pl. 5, 1929.

NORDBY, J. E. An inherited skull defect in swine. Journ. Heredity, vol. 20, pp. 229–232. May, 1929.

——— Congenital skin, ear, and skull defects in a pig. Anat. Rec., vol. 42, pp 267–280, illus. May 25, 1929.

OGNEFF, S. J. Über einige Nagetiere Ostsibirens. Zool. Anzeiger, vol. 84, pp. 71–89, June 15, 1929. (New: *Pteromys volans turovi; Sciurus vulgaris dukeiti; Sc. vulgaris jakutensis* natio *anadyrensis; Microtus oeconomus shantaricus.*)

OSBORN, HENRY FAIRFIELD. *Embolotherium*, Gen. Nov., of the Ulan Gochu, Mongolia. Amer. Mus. Novitates, No. 353, pp. 1–20, May 30, 1929.

PONTIER, GEORGES. Suite de l'étude sur les molaires d'éléphants quaternaires de la vallée de le Seine provenant de la collection Emile Rivière. Bull. Soc. Préhist. France, vol. 26, No. 1, pp. 62–68, fig. 1, 1929. (Mixing of arctic and tropical faunas due to co-existance of Chellean and Mousterian in Parisian Zone.)

POOLE, CHARLES G. A zoological contradiction. Monthly Bull. Dept. Agric. California, vol. 18, No. 5, pp. 316–318, figs. 2, May 1929.

RAJEWSKI, W. W., AND L. G. KAPLANOFF. Übersicht der Säugetiere der oberer Wolga. Zool. Anzeiger, vol. 84, pp. 140–151, August 10, 1929. (Lists 52 forms, one of which is new: *Evotomys rutilus volgensis.*)

RAO, C. R. NARAYAN. Dinosaurian and mammalian remains in South India. Nature (London), vol. 124, p. 227, fig. 1, August 10, 1929.

REINWALDT, EDWIN. Über verbreitung und Schutz einiger Säugetiere Estlands nach Daten einer Enquete der Naturschutzsection der Naturforscher-Gesellschaft der Universität Tartu (Dorpat). Loodusuurijate Saltsi Looduskaitse Sektsiooni toim, No. 1, pp 1–19, 1927.

REVILLIOD, P. A propos de la dentition d'Archaeonycteris. Actes Soc. Helvétique Sci. Nat., No. 109, pt. 2, pp. 222–223, 1928.

RIESENTHAL, EBERHARD. Ueber den Paarungsakt des Bibers. Naturforscher, Berlin, vol. 6, No. 2, pp. 66–67, May 1929.

SCHNEIDER, KARL MAX. Ein weiterer junger brauner Schimpanse. Zool. Garten, N. F., vol. 1, pp. 182–195, figs. 1–9, 1928.

SHELFORD, VICTOR E. Laboratory and field ecology. The responses of animals as indicators of correct working methods. Baltimore: Williams and Wilkins Co. 12 + 608 pp., 219 figs., bibliogr. 1929.

SIMPSON, GEORGE GAYLORD. Further notes on Mongolian Cretaceous Mammals. Amer. Mus. Novitates No. 329, pp. 1–14, figs. 7, 1928.

——— Pleistocene mammals from a cave in Citrus County, Florida. Amer. Mus. Novitates, No. 328, pp. 1–16, figs. 11, October 26, 1928. (New: *Thomomys orientalis; Synaptomys australis; Hydrochoerus holmesi; Blastocerus extransus.*)

——— Paleocene and Lower Eocene Mammals of Europe. Amer. Mus. Novitates, No. 354, pp. 1–17, June 5, 1929.

——— Affinities of the Mongolian Cretaceous Insectivores. Amer. Mus. Novitates, No. 330, pp. 1–11, October 30, 1928.

SIMPSON, GEORGE G. AND HERBERT ELFTMAN. Hind Limb Musculature and Habits of a Paleocene Multituberculate. Amer. Mus. Novitates, No. 333 pp. 1–19, November 1, 1928.

SKIDMORE, L. V. Note on a new species of Coccidia from the pocket gopher (*Geomys bursarius* Shaw). Journ. Parasitology, vol. 15, pp. 183–184, 1 fig. March, 1929.

SMIRNOW, G. G., AND M. TH. GLASUNOW. Über die Blutveränderung beim Meerschweinchen nach einmalige und wiederholter Ascarideninfektion. Zeitschr. f. Parasitenkunde, vol. 1, pp. 174–197, 18 figs. April 17, 1928.

SMITH, BURNETT. Recent finds of quaternary mammals at Syracuse, New York. New York State Museum, Albany, Bull. 281, pp. 21–23, fig. 12. 1929.

SODY, H. J. V. Naamlijst van de vleermuizen van Java. Natuurkundig Tijdschr Nederlandsch-Indie, vol. 89, No. 1, pp. 28–66, 1929. (Lists 58 forms of Bats.)

LE SOUEF, A. S. Occurrence of the crab-eating seal *Lobodon carcinophaga* Hombron & Jacuinot, in New South Wales. Australia Zool., vol. 6, No. 1, p.99, pl. 1, August 13, 1929.

SOWERBY, ARTHUR DE C. The Baluchitherium, the largest land mammal that ever lived. China Journ. vol. 11, pp. 95–98, 4 pls. August, 1929.

SPIEGEL, A. Biologische Beobachtungen an Javamakaken, Macacus irus F. Cuv. (cynomologus L.) Zool. Anzeiger., vol. 81, pp. 37–65, figs. 1–10. April 1, 1929.

SPILLMANN, FR. Das Letzte Mastodon von Südamerika. Bericht Sencken. Naturf. Gesell., vol. 59, No. 2, pp. 119–123, pl. 1, fig. 4, February 1929. (Skeleton of a mastodon apparently killed by spears found on Inter-Andean plateau of Ecuador).

ST. LEGER, JANE. An interesting Collection of Mammals, with a remarkable new Species of Hare from Uganda. Ann. & Mag. Nat. Hist., Ser. 10, vol. 4, pp. 290–294, September 1929 (Lists six forms of which *Lepus majorita* is new.)

ST. LEGER, JANE. A new Gerbil from Kordofan. Ann. & Mag. Nat. Hist., Ser. 10, vol. 4, pp. 295–296, September 1929. (New: *Gerbillus rosalinda.*)

STOCK, CHESTER. Significance of abraded and weathered mammalian remains from Rancho La Brea. Bull. Southern Calif, Acad. Sci., vol. 28, No. 1, pp. 1–5, pls. 2, 1929.

STURMAN-HULBE, M., AND C. P. STONE. Maternal behavior in the albino rat. Journ. Comp. Psych., vol. 9, pp. 203–327, 8 figs. June, 1929.

SUNIER, A. L. J. C. Kerbert. Zeit. f. Säugetierkunde, vol. 2, p. 197, pl. 2, (Port.). April 29, 1929. (Biographical.)

TALBOT, P. Do hedgehogs suck cows. Field, London, vol. 154, p. 255. August 17, 1929.

TEALL, RALPH. Coyotes at Glacier Point. Yosemite Nature Notes, vol. 8, p. 89. September, 1929.

THEMIDO, ANTONIO A. Catalogue des Primates existants dans les collections du Muséum Zoologique de Coimbra. Mem. e. Estud. Mus. Zool. Coimbra, vol. 1, No. 19, pp. 5–30, 1928.

THEODOR, O. Über ein nicht pathogenes Trypanosoma aus der Ziege und seine Übertragung durch Lipoptena caprina Aust. Zeitschr. f. Parasitenkunde, vol. 1, pp. 283–330, 15 figs., 2 pls. Aug. 10, 1928.

THOMAS, OLDFIELD. The South Tenasserim race of *Paguma leucomystax*, Gray. Ann. & Mag. Nat. Hist., Ser. 10, vol. 2, No. 7, pp. 101–102, July 1928. (New: *Paguma leucomystax janetta.*)

——— The Delacour exploration of French Indo-China. Mammals. 3. Mammals collected during the winter of 1927–1928. Proc. Zool. Soc. London, 1928, (4), pp. 831–841, January 31, 1929. (New: *Felis affinis fulvidina; Callosciurus flavimanus pirata; C. ferrugineus menamicus; C. ferrugineus annellatus.*)

——— On Mammals from the Kaoko-Veld, Southwest Africa, obtained during Captain Shortridge's Fifth Percy Sladen and Kaffrarian Museum Expedition. Proc. Zool. Soc. London, 1929, Pt. 1, pp. 99–111, April 30, 1929. (New: *Geosciurus princeps; Pronolagus caucinus; Bunolagus*, g. n.)

TROUGHTON, E. LE G. Note on the occurrence of a second species of Fruit-bat (*Pteropus scapulatus*) in New South Wales. Australian Zool., vol. 6, No. 1, pp. 104–106, August 13, 1929.

TROUGHTON, E. LE G., AND A. S. LE SOUEF. New forms of Mosaic-tailed rats (*Melomys* and *Uromys*) from Hinchinbrook Island, Queensland. Australian Zool., vol. 6, No. 1, pp. 96–99, August 13, 1929. (New: *Melomys littoralis insulae; M. cervinipes pallidus; Uromys macropus exilis.*)

UGAROV, A. A. Contributions to the systematic of the genus *Ellobius* Fischer. Acta Univ. Asiae Mediae, Taschkent, Zool., Fasc. 4, pp. 3–19, pl. 1, figs. 3, 1928. (Russian text; English summary). (New: *Ellobius farsistani.*)

UNNEWEHR, GEORGE L. Black bear kills fawn. Yosemite Nature Notes, vol. 8, p. 83. August, 1929.

VALENTINE, W. L. Visual perception in the white rat. Jour. Comp. Psych., vol. 8, pp. 369–375, fig. December, 1928.

WARD, A. E. The Mammals and Birds of Kashmir and the adjacent Hill Provinces. Pt. 7. Journ. Bombay Nat. Hist. Soc., vol. 32, No. 4, pp. 711–716, May 31, 1928.

WHITE, P. J. Billy, the bear, sets a record. Yosemite Nature Notes, vol. 8, pp. 96–97. October, 1929. (Black bear eats 72 flapjacks.)

WIESEL, L. Beiträge zur Morphologie der Biberarten. Zeitschr. f. Morphologie u. Ökologie der Tiere, vol. 14, pp. 421–512, 4 figs. April 23, 1929.

WOOD, HORACE ELMER, 2ND. *Prohyracodon orientale* Koch, the oldest known rhinoceros. (Abstr.), Bull. Geol. Soc. Amer., vol. 40, No. 1, p. 221, March, 1929.

WOODROW, H. Discrimination by the monkey of temporal sequences of varying number of stimuli. Journ. Comp. Psych., vol. 9, pp. 123–157, 3 figs. April, 1929.

——— Temporal discrimination in the monkey. Journ. Comp. Psych., vol. 8, pp. 395–427, 3 figs. December, 1928.

WU, H. W. On *Halocercus pingi* n. sp. a lung-worm from the porpoise, *Meomeris phocoenoides*. Journ. Parasitology, vol. 15, pp. 276–279, 7 figs. June, 1929.

YOSHIOKA, J. G. A note on a right or left going position habit with rats. Journ. Comp. Psych., vol. 8, pp. 429–433, 1 fig. December, 1928.

COMMENT AND NEWS

THE COUNCIL FOR THE CONSERVATION OF WHALES

At its tenth annual meeting, April 13, 1928, the American Society of Mammalogists passed the following resolution:

> "Whereas; It has been disclosed that the operations for the capture of whales and utilization of whale products as now conducted result in much economic waste and such slaughter of the animals as seriously endangers the existing supply of these mammals and the conservation of an important natural resource. Now, therefore, be it
>
> "Resolved: That the American Society of Mammalogists at its tenth annual meeting recommends that steps be taken looking to the appointment of an international commission to investigate conditions and facts regarding the life history, habits, and commercial utilization of whales, and to make recommendations to the governments concerned as to procedure or regulations which will safeguard and perpetuate this resource for the benefit of all parties interested."

The Corresponding Secretary of the Society was accordingly instructed to take such action in the matter as seemed to him most feasible, which he has proceeded to do with the full and able coöperation of Remington Kellogg.

The first consideration was to obtain an accurate idea of the status of this question throughout the world—what general feeling there was for and against the regulation of whaling, and what steps had been and were being taken abroad. It was necessary that this be done before an intelligent policy could be formulated in America, and it was not until late in 1928 that this preliminary investigation was considered to be accomplished in a satisfactory manner.

Abroad, the organization most concerned with the reasonable conservation of whales is a committee of the Permanent International Council for the Exploration of the Sea. Professor Hjort is chairman of this committee and upon it are represented fifteen European political divisions. In 1925 a British expedition was dispatched upon the Royal Research Ship 'Discovery' with the object of investigating throughout the far south the present status of whales and whaling operations. It seems, however, that whales are being killed at such an ever-increasing rate that by the time that this investigation shall have been completed and recommendations made, further irreparable damage to the stocks of the larger cetaceans may have been done. It was accordingly decided by those of us concerned that the most promising plan was for an American organization to attempt independent accomplishment, but with the closest possible coöperation with European efforts.

In making our plans we were fortunate in being able to enlist the interest of some extremely able men, and after some deliberation it was decided to establish a Council for the Conservation of Whales, composed of an Advisory Board and a Technical Committee, with the Corresponding Secretary of the American Society of Mammalogists as Executive Secretary, the Council to be under the auspices of the Society. This was forthwith established. The individuals who consented to serve on the Advisory Board were as follows, with individual representation at that time as stated, although there has been subsequent change of connection in the case of some of them. Glover M. Allen, President of the American Society of Mammalogists; Carlos Avery, President of the American Game Protective and

Propagation Association; Barton W. Evermann, Chairman of the National Research Council's Committee on Conservation of Marine Life in the Pacific; Frank J. Goodnow, President of Johns Hopkins University; Madison Grant, President of the New York Zoological Society; George Bird Grinnell, Honorary President of the Boone and Crockett Club; Gilbert H. Grosvenor, President of the National Geographic Society; Chauncey J. Hamlin, President of the Buffalo Society of Natural Sciences; William T. Hornaday, Permanent Wild Life Protective Fund; David Starr Jordan, President Emeritus of Stanford University; Vernon L. Kellogg, Permanent Secretary of the National Research Council; Clarence C. Little, President of the University of Michigan; John C. Merriam, President of the Carnegie Institution of Washington; Henry Fairfield Osborn, President of the American Museum of Natural History; John C. Phillips, President of American Wild Fowlers; T. Gilbert Pearson, President of the National Association of Audubon Societies; Gifford Pinchot, Conservationist; I. T. Quinn, Chairman of the National Game Conference; George Shiras 3rd, Conservationist; T. Wayland Vaughan, Director of the Scripps Institution of Oceanography; Henry B. Ward, President of the Izaak Walton League of America; Lewis H. Weed, Dean of the Johns Hopkins Medical School; and Ray Lyman Wilbur, President of Stanford University. The New York Zoological Society has since withdrawn and Mr. Grant has resigned from the Council.

The Technical Committee was headed by Remington Kellogg as Chairman, and was composed as follows: Glover M. Allen, A. Brazier Howell, Nagamichi Kuroda, Frederick D. Meisnest, Gerrit S. Miller, Jr., Theodore S. Palmer, Charles H. Townsend, G. Van Gelder, and Howard I. Wordell, the last two individuals representing the whale products interests. Dr. Townsend has recently resigned from the committee.

No general campaign for funds was undertaken but in response to a request for sufficient to cover stationary, postage and multigraphing, made to a few individuals, the Permanent Wild Life Fund, through Dr. Hornaday, and the American Wild Fowlers, through Dr. Phillips, generously contributed the necessary funds.

The next step was to formulate a policy which was desirable and which seemed practicable of final accomplishment. It should be clearly understood that the Council has no wish to secure the entire cessation of whaling, but only such restrictive measures as shall ensure the perpetuation of an adequate breeding stock of whales to the end that the industry can be maintained indefinitely, rather than that a speedy end should overtake it. It was accordingly determined that the following reforms were highly desirable and that an effort to secure their adoption should be the goal of the Council:

Immediate and absolute protection of such species of whales as are in serious danger of extermination.

Protection of whales on certain rather circumscribed areas which they now use as breeding grounds.

Protection of females nursing young.

Compulsory utilization by whalers of the entire carcass.

Prohibition of whaling in certain tropical areas where the animals are almost invariably too thin to be profitable.

Prohibition of the use of airplanes for whale hunting.

Establishment of an international committee; to operate a system for the licensing of the pelagic whaler; to secure coöperation of individual nations in licensing shore whaling stations, and in supervising their activities; and to make proper investigations and secure data on the conditions of whales.

To accomplish international action is never easy, and when the question under consideration involves the freedom of the seas the difficulties are greatly multiplied. Accordingly it has been realized that if anything were to be accomplished a period of careful preparation would first be necessary. There has been much to do, and far from an adequate amount of time could be spared from other urgent or official duties. The Executive Secretary has concerned himself with the rather heavy correspondence involved, with securing the moral support of biological organizations throughout the world, with preparing and obtaining from others releases concerning whales for the daily press, in order that the public might be informed of the urgency of adopting protective measures for whales, and with the securing of magazine articles toward the same end. Meanwhile Dr. Kellogg, with the coöperation of F. D. Meisnest, has attended to the arduous task of gathering, compiling, and digesting statistics on whaling in all parts of the world. This has been absolutely essential and it has taken a formidable amount of time. Little of consequence could be accomplished without such data. This is now nearing completion, however, and thought can be taken regarding further action. Certain influential members of the Advisory Board are accordingly bestirring themselves and it is fully expected that the preliminary phase of our undertaking will very speedily have been left behind.

Our course of action for the immediate future has not been determined with exactitude, as it depends far more on others than upon the members of the Council. The subject will have strong representation properly placed, but the feasibility of international action at the present time, when large questions of the relations and armaments of nations are in the air, is a matter yet to be determined.

In this regard the recent action by Norway seems highly auspicious. In the past one might logically have presumed that the Norwegians would present the strongest objections to the regulation of whaling, for they now do four-fifths of the world's whaling and consequently any immediate hardships that regulation would entail would fall heaviest upon them. Therefore it is to her everlasting credit that upon June 25, 1929, Norway passed of her own accord the best whaling law that any country has ever adopted. This applies to all ships flying the Norwegian flag, and of course, to her own shore stations. It entirely prohibits the capture of right whales, cows of any species accompanied by calves, and calves accompanying cows. It leaves to the discretion of the king the prohibition of whaling in tropical and sub-tropical waters within certain prescribed limits. It provides for regulations to effect fuller utilization of carcasses than is now the practice on floating factories. It stipulates that the crews of whaling vessels shall not be paid upon the basis of number of whales killed. It provides for a tax upon whaling products, to be used in defrayment of expenses incurred in enforcing the law and to be applied to cetacean research, and fixes fines and imprisonment for transgression of the law, this including confiscation of the catch. By royal resolution a central institution has been formed to gather international statistics on whaling.

If fairly immediate results can be obtained toward proper and reasonable conservation of whales on an international basis it is immaterial to the American Council whether the accomplishment be credited to New World or Old World efforts. If it shall prove that the time is not yet propitious for the introduction of this subject into international deliberations, fully occupied with matters which to the majority appear of graver import, a start in the right direction will at least have been initiated which we may confidently expect will gather unto itself within a few years sufficient momentum to reach the desired goal.

The attention of the members of the Society is again called to the fact that an enlarged committee on membership has been constituted. It is the hope of the members of this committee that everyone in the Society will agree with them as to the importance of serious effort to build up our membership. The Society has amply justified its existence during its comparatively short life and serves a very useful purpose in its field. Its position is now firmly established and the importance of its work in mammalogy generally recognized throughout the country. The scope of its activities and consequent usefulness, however, may be very materially broadened by an enlargement of its membership with the resultant increase in its financial resources. The material available and suitable for publication in the Journal far exceeds its present capacity. But this capacity cannot be materially increased and so maintained without additional revenue from dues. The committee feels quite strongly that the most effective way to obtain new members is through some measure of personal effort by the present members among their acquaintances, and ventures to ask the active coöperation of all who have the Society's interests at heart.

The committee proposes to supplement the individual efforts of the members with a more general campaign, the plan of which will be submitted as soon as ready.

On the occasion of the meeting of the American Society of Mammalogists, held at Ann Arbor, Michigan, April 10–13, 1929, H. H. T. Jackson tendered his resignation as editor of the Journal, a post he has filled most acceptably for several years, stipulating that his resignation take effect after closing the current volume. It was found impracticable to elect another editor, due to a dearth of candidates. Realizing that this contingency necessitated providing for the two numbers that must be issued prior to the date of the next meeting, it was decided to appoint a committee to take over this work. In accordance with a resolution passed at the final business meeting, Edward A. Preble, of Washington, D. C., was appointed chairman of this committee, with the privilege of naming further members. This committee, as at present constituted, is as follows: Edward A. Preble, Biological Survey, Washington, D. C., chairman; Glover M. Allen, Museum of Comparative Zoölogy, Cambridge, Mass.; Arthur H. Howell, Biological Survey, Washington, D. C.; Remington Kellogg, U. S. National Museum, Washington, D. C.; Gerrit S. Miller, Jr., U. S. National Museum, and George B. Wislocki, Johns Hopkins University, Baltimore, Maryland.

The chairman wishes to acknowledge the able assistance of the members of this committee in the work of editing the present number, and desires also to thank Doctor Jackson for kindly advice based on his long experience as editor of the journal of the Society.

With the February issue the Journal of Mammalogy begins the second decade of its career. It celebrates the occasion by appearing in new habiliment designed and presented by A. Brazier Howell.

The eleventh annual meeting of the American Society of Mammalogists will be held at the American Museum of Natural History, New York City, from Wednesday, May 21, to Saturday, May 24, 1930. A meeting of the directors will also be held at the American Museum at 8 P.M., Tuesday, May 20.

The Hotel Emerson, 166 W. 75th St. has been designated as headquarters and reservations for rooms should be made in advance. All rooms have baths and rates vary from $2.50 for single and $3.50 for double rooms.

It is planned to have a short symposium on the utilization of zoological park collections for research, under the arrangement of Dr. W. Reid Blair, and another longer one on the anthropoid apes. In addition there will probably be grouped papers relating to other particular topics, notably conservation. Titles of papers must be in the hands of the corresponding secretary not later than May 1, and it is requested that without fail the time for delivery be stated and whether or not slides will be used. Papers should not occupy a greater length of time than 30 minutes unless illustrated by motion pictures.

Members are requested to bear in mind the dates of the meeting, for they will have no further notice until they receive the program in the middle of May.

Local committee on arrangements: H. E. Anthony, chairman, W. Reid Blair, R. T. Hatt.

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Department of Anatomy, Johns Hopkins Medical School, Baltimore, Md.

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